Feasibility and Accuracy of Record Linkage To Estimate Multiple Program Participation

Volume III, Survey of Food Assistance Information Systems—Results of Record Linkage

By Nancy Cole and Ellie Lee, Abt Associates Inc.

ERS project representative: Mark Prell, 202-694-5408
mprell@ers.usda.gov

Abstract

This study investigated the feasibility of linking administrative data from multiple USDA food assistance and nutrition programs. This report contains findings from Phase II of the study, which collected and linked 2000-02 administrative data on clients of the Food Stamp Program (FSP) and the Special Supplemental Program for Women, Infants, and Children (WIC) in Florida, Iowa, and Kentucky. The report finds that the percentage of FSP infants (children) with contemporaneous participation in WIC ranged from 84 to 94 percent (50 to 57 percent). Meanwhile, the percentage of WIC infants (children) with contemporaneous participation in FSP ranged from 22 to 38 percent (29 to 50 percent). Most FSP women who gave birth during the 3-year period participated in WIC for some period (83 percent in Florida and 91 percent in Iowa). Phase II also examined the relative timing of participation across programs and the individual and household characteristics associated with multiple program participation.

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Executive Summary

This study investigated the feasibility of linking administrative data from multiple USDA food assistance and nutrition programs (FANPs). Linked data provide a means of examining rates of multiple program participation, dynamics of participation across programs, and the characteristics of families who participate in some, but not all, FANP programs for which they are eligible. The study was conducted in two phases.

Phase I of the study examined the characteristics and content of administrative databases that maintain information about participants in food assistance programs. Information about administrative databases was collected with the Survey of Food Assistance Information Systems. Respondents to the survey included State directors of the Food Stamp Program (FSP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and Child Nutrition Programs (CNPs) in 26 States representing 76 percent of total FSP and WIC participants in the United States. The main goal of the survey was to determine the potential for record linkage across programs.

Results of phase 1 were reported in *Volume I: Record Linkage Issues and Results of the Survey of Food Assistance Information Systems.*[1] That report includes:

- Review of research uses of administrative data;
- Description of record linkage methods; and
- Description of information systems containing participant information for the Food Stamp Program, WIC, and Child Nutrition Programs.

Phase II of the study, reported in this volume, collected retrospective administrative data from food stamp and WIC programs in three States (Florida, Iowa, and Kentucky) covering a three-year period (January 2000 through December 2002). FSP and WIC records were matched using probabalistic record linkage methods. Match results were used as estimates of multiple program participation within each State. This report includes:

- Estimates of multiple program participation in FSP and WIC;
- Description of the relative timing of participation across programs;
- Examination of the individual and household characteristics associated with multiple program participation.

In addition, information about the feasibility of record linkage is presented through a discussion of the content of administrative databases, the prevalence of missing or non-standardized data, the rate of change in participant information over time, and the methods used for record linkage.

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[1] Cole, Nancy. *Feasibility and Accuracy of Record Linkage To Estimate Multiple Program Participation: Volume I, Record Linkage Issues and Results of the Survey of Food Assistance Information Systems*, E-FAN-03-008-1 and *Feasibility and Accuracy of Record Linkage To Estimate Multiple Program Participation: Volume II, Survey of Food Assistance Information Systems – Survey Instruments*, E-FAN-03-008-2

Findings of the Survey of Food Assistance Information Systems

The findings of the Survey of Food Assistance Information Systems in 26 States indicated variation in the characteristics of participant databases within and between the FSP and WIC programs. Systems differed with respect to the number and types of available person identifiers, extent of data verification, and rules for data retention and overwriting. These findings suggest that administrative data needed for file matching vary in reliability across States and programs. The survey also found that participant data from the Child Nutrition Programs are currently unavailable at the State level except from a handful of States.

The characteristics of information systems that are most relevant to research on multiple program participation are:

- There is currently no integration between information systems for FSP, WIC, and Child Nutrition Programs.

- All 26 States surveyed have statewide information systems for FSP and WIC; only 5 States maintain information about eligibility for the National School Lunch Program at the state level.

- The potential to link FSP and WIC data using Social Security Numbers (SSNs) as a primary identifier may be limited. In all 26 sampled States, FSP collects and verifies the SSN of each participant. Reporting of SSN by WIC applicants, however, varies by State: 5 States require SSNs, if available; SSN is optional in 15 States; and 6 States do not collect SSN. Only one WIC program reported that SSNs are verified.

- The potential to link FSP and WIC data for persons participating in both programs at different points in time may be limited by the overwriting policies on individual data fields such as last name (which may change due to marriage, divorce, or adoption), address and telephone number. More than three-fourths of WIC programs overwrite this information when it changes, rather than retaining the information. FSP programs are more likely to retain old information in their on-line systems.

Findings of FSP and WIC Record Linkage

Multiple program participation was examined by within-State linking of FSP and WIC data from Florida, Iowa, and Kentucky. These three States were selected for the study based on favorable characteristics of their FSP and WIC information systems, as reported in the phase I survey.[2] Thus, the feasibility of record linkage in these three States may not be indicative of the potential for successful record linkage in other States.

Records from the FSP and WIC programs were matched using probabilistic record linkage software from the U.S. Bureau of Census. Match results were used as estimates of multiple program participation within each State. Two measures of multiple program participation were examined:

- **Contemporaneous participation** – participation in FSP and WIC at a point in time; measured by matching all FSP participants active in December 2002 to all WIC participants active in December 2002.

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[2]   The FSP and WIC programs in these three States each have name, address, date of birth, and SSN in their administrative databases as required fields that are not supposed to be blank. These are the key identifiers used for record linkage.

- **Exposure** – participation in FSP and WIC at any time during the three-year period from January 2000 through December 2002; measured by matching all persons participating in FSP at any time during the three-year period, to all persons participating in WIC at any time during the three-year period.

Infants and children. Rates of multiple program participation are shown in figure 1 for FSP infants and children (rates of exposure during the three year period could not be estimated for Kentucky). Contemporaneous match rates are significantly higher for FSP infants compared with FSP children.

Over 80 percent of FSP infants in all three States had contemporaneous participation in WIC, while 50 to 57 percent of FSP children had contemporaneous participation in WIC. The difference between infants and children reflects declining WIC participation with age. Rates of exposure to WIC during the three-year time period are only 5-6 percentage points higher for infants, compared to children.

For WIC participants, rates of contemporaneous multiple program participation and rates of exposure to FSP are lower than corresponding rates of participation in WIC among FSP participants. For WIC participants, rates of participation in FSP are limited by the fact that only a subset of WIC participants are income-eligible for FSP. Rates of multiple program participation for WIC infants and children are shown in figure 2.

- The percent of WIC infants with contemporaneous participation in FSP was 24 percent in Florida, 22 percent in Iowa, and 38 percent in Kentucky.
- The percent of WIC children with contemporaneous participation in FSP was 35 percent in Florida, 29 percent in Iowa, and 50 percent in Kentucky.

Figure 1 — Percent of FSP infants and children participating in WIC
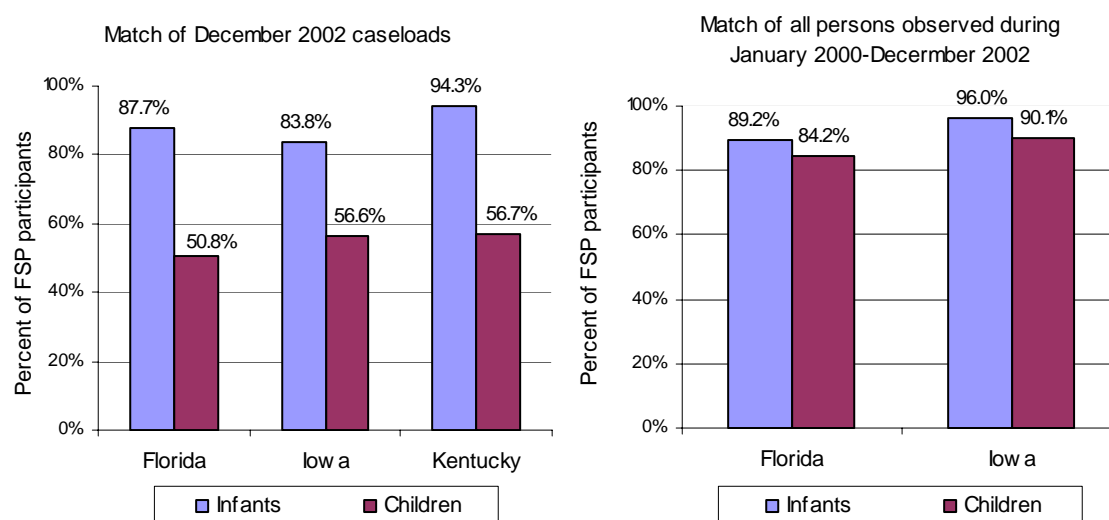
Note: Kentucky could not be matched over the period January 2000 through December 2002 because Kentucky FSP data were available for December 2002 only.

Figure 2 — Percent of WIC infants and children participating in FSP

Match of December 2002 caseloads

Match of all persons observed during
January 2000-Decermber 2002

Note: Kentucky could not be matched over the period January 2000 through December 2002 because Kentucky FSP data were available
for December 2002 only.
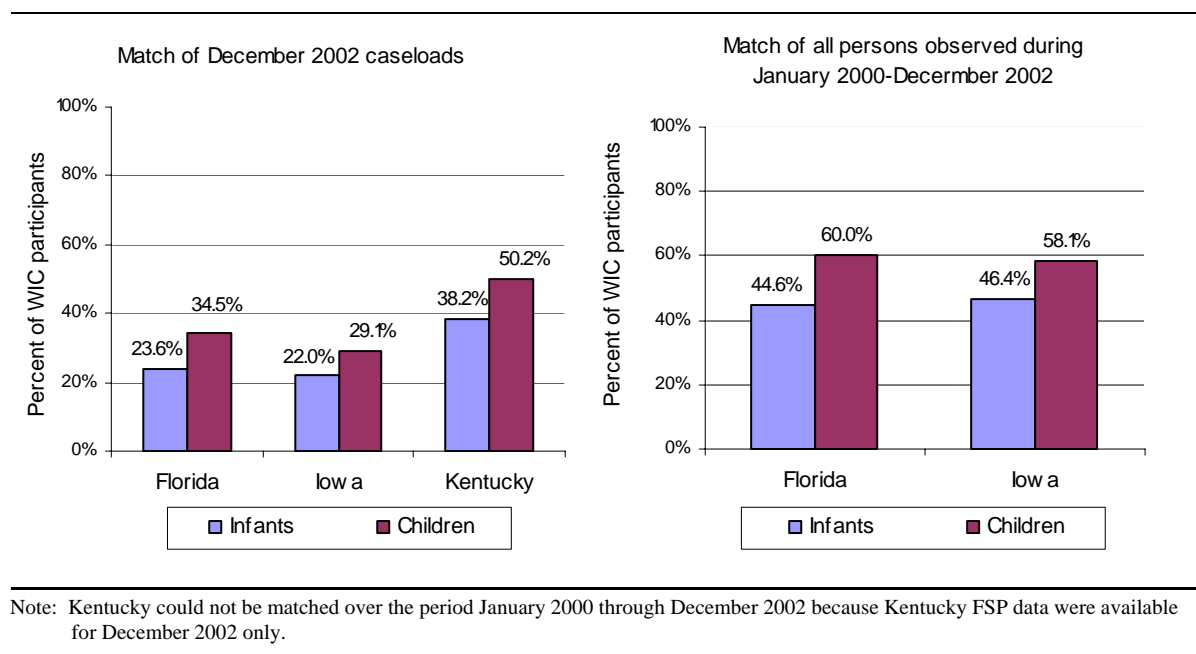
Rates of exposure of WIC infants and children to FSP during the three-year period were 45 and 60 percent for infants and children in Florida, respectively; and 46 and 58 percent for infants and children in Iowa, respectively. (This statistic could not be estimated for Kentucky).

Multivariate analysis was used to examine the characteristics of FSP participants who also participate in WIC (the converse was not examined because not all WIC participants are eligible for FSP). This analysis shows that the likelihood that FSP children participate in WIC declines with age and is negatively associated with residence in a metropolitan area. Hispanic children in Florida and Kentucky were more likely to participate in WIC than other racial/ethnic groups, and black children in Iowa and Kentucky were less likely to participate in WIC than other racial/ethnic groups. In all three States, the likelihood of WIC participation is positively associated with the number of adults in the household, the number of children under age five, a married household head, and receipt of TANF. Medicaid enrollment is positively related to WIC participation in Iowa (the only State with Medicaid information). Since the analysis was limited to FSP participants, the TANF and Medicaid results suggest that WIC participation is more likely when children are enrolled in *multiple* other public assistance programs.

Women. Most FSP women who gave birth during the three-year period (2000-2002) participated in WIC for some period of time (78 percent in Florida and 85 percent in Iowa). Half of FSP women with infants were enrolled in FSP prior to WIC. Among FSP women with infants who participated in WIC, the timing of participation is shown in figure 3: 57 percent in Florida and 65 percent in Iowa participated in WIC during pregnancy and postpartum. However, more than one-quarter (26 percent in Florida and 28 percent in Iowa) participated in WIC only postpartum and not during the prenatal period.

Figure 3 ⎯ Timing of WIC participation for FSP women with infants
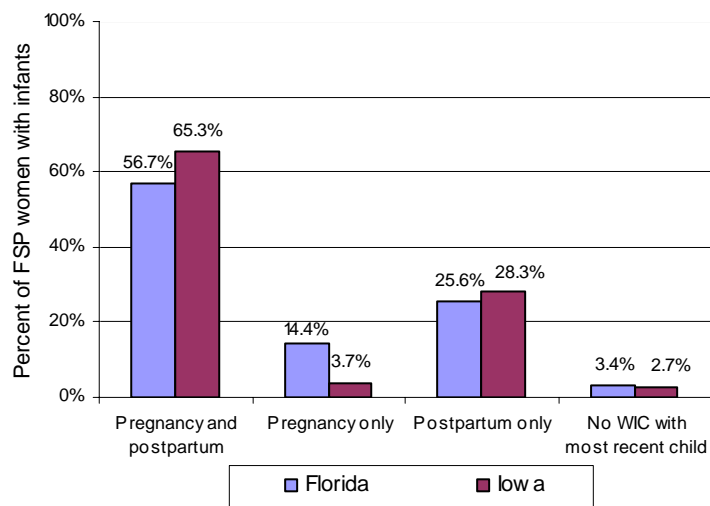
Note: Sample is limited to FSP women with infants who participated in WIC at some time during January 2000 – December 2002. The percent of FSP women with infants who participated in WIC in Florida and Iowa was 78 and 85 percent, respectively.

The multiple program participation results from this report cannot be generalized beyond the three States included in the study. The range of issues examined, however, can be applied to further studies. Linked administrative data may be less costly than survey data and provide a means of examining a large number of issues associated with multiple program participation. For example, the current study might be replicated with a larger time period so that the interaction of FSP and WIC can be examined for cohorts of children from birth to age 5. These methods may also be applied to data from other public assistance programs. Unfortunately, NSLP data were not available for the record linkage portion of this study, but future efforts to link NLSP and FSP could help us understand variations in FSP participation rates among school-age children.

Chapter One

Introduction

This report is part of a larger study examining the *Feasibility and Accuracy of Record Linkage to Estimate Multiple Program Participation*. The overall study investigates the feasibility of linking administrative data from multiple USDA food assistance and nutrition programs (FANPs). Linked data provide a means of examining rates of multiple program participation, dynamics of participation across programs, and the characteristics of families who participate in some, but not all FANP programs for which they are eligible.

Phase 2 of the study, reported in this volume, collected retrospective administrative caseload data from food stamp and WIC programs in three States (Florida, Iowa, and Kentucky). Data were collected covering the three-year period 2000 to 2002. Records from the FSP and WIC programs were matched using probabilistic record linkage software from the U.S. Bureau of Census. Match results were used as estimates of multiple program participation within each State.

Two measures of multiple program participation are of interest in characterizing the experiences of program participants: contemporaneous participation and exposure. Contemporaneous participation is participation in multiple programs at a point in time; exposure is participation in multiple programs during an extended period, but not necessarily at the same time. In this study, rates of contemporaneous multiple program participation are obtained by matching FSP and WIC caseloads from a single month (December 2002). Rates of multiple program exposure during the three-year period from 2000 to 2002 are obtained by matching all persons participating in FSP at any time during the three-year period, to all persons participating in WIC at any time during the three-year period.

Main Findings

For the three States studied, the percent of FSP infants with contemporaneous participation in WIC during a single month ranged from 84 to 94 percent across States, with 89 to 96 percent of FSP infants exposed to WIC at some point during the three-year period. For FSP children, the rates of contemporaneous WIC participation ranged from 51 to 57 percent across States, with 61 to 74 percent exposed to WIC at some point during the three-year period. Nearly all FSP infants and children exposed to WIC had concurrent participation for at least some period of time.

Most FSP women who gave birth during the three-year period, 2000-2002, participated in WIC for some period of time (78 percent in Florida and 85 percent in Iowa).[3] Half of FSP women with infants were enrolled in FSP prior to WIC. Among FSP women with infants who participated in WIC, 57 percent in Florida and 65 percent in Iowa participated in WIC during pregnancy and postpartum. However, more than one-quarter (26 percent in Florida and 28 percent in Iowa) participated in WIC only postpartum and not during the prenatal period.

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[3]   These statistics could not be estimated for Kentucky.

While all FSP participants are income-eligible for WIC, only a subset of WIC participants is income-eligible for FSP.[4] The percent of WIC participants with contemporaneous participation in FSP during a single month was estimated to be 28 percent in Florida, 26 percent in Iowa, and 45 percent in Kentucky, with somewhat higher rates for children than for women and infants.[5] The percent of WIC participants exposed to FSP during the three-year period was 52 percent in Florida and 55 percent in Iowa (this statistic could not be estimated for Kentucky).

Participation histories were examined separately for FSP and WIC. The length of time participating in each program was measured by the total number of months of participation during the three-year period, which need not be continuous. During 2000-2002, women and children participated in FSP longer than in WIC, while infants participated in WIC longer than in FSP. This is consistent with program rules that limit women's participation to periods around childbirth, and is consistent with the decline in WIC participation as children age. Analysis of birth cohorts through age five shows that overall program participation (participating in either FSP or WIC) declines with age, with most of the decline due to declining WIC participation.

Multivariate analyses shows that the likelihood of WIC participation among FSP children declines with age and is negatively associated with residence in a metropolitan area. Hispanic children in Florida and Kentucky were more likely to participate in WIC than other racial/ethnic groups, and black children in Iowa and Kentucky were less likely to participate in WIC than other racial/ethnic groups. In all three States, the likelihood of WIC participation by FSP children is positively associated with the number of adults in the household, the number of children under age five, a married household head, and receipt of TANF. Medicaid enrollment is positively related to WIC participation in Iowa (the only State with Medicaid information). Since the analysis was limited to FSP participants, the TANF and Medicaid results suggest that WIC participation is more likely when children are enrolled in *multiple* other public assistance programs. Multivariate analyses of the covariates of WIC participation for FSP infants showed inconsistent results across States.

Because match rates are used as estimates of multiple program participation, it is important to consider the sensitivity of match results to match methods. This study found that probabilistic record linkage methods provide improvement in match rates over those obtained by simpler methods. The greatest improvement in match rates was for infants, whose records were often missing key identifying information. These results cannot be generalized to other States, however, because match results vary with the number and quality of available identifiers.

Although this study provides important information about multiple program participation and the timing of participation across programs, the three States included in the study are not representative of all States. In addition, the time period examined, from 2000 through 2002, was a period of low participation in both FSP and WIC, and may not provide rates of multiple program participation that would be observed in periods of greater participation.[6]

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[4] The income-eligibility cutoffs for FSP and WIC are 130 and 185 percent of the federal poverty guidelines, respectively.

[5] For Florida and Iowa, the contemporaneous match rates were consistent with the overall rates of FSP participation reported in the WIC administrative data.

[6] Average monthly FSP participation during 2000-2002 ranged from 17 to 19 million, compared to 25 to 27 million during 1992-1996 (USDA/FNS, 2004a). Average monthly WIC participation in 2000 was 7.1 million, having declined from a high of 7.4 million in 1997; WIC participation rose to 7.3 in 2001 and 7.4 in 2002. (USDA/FNS, 2004b)

The remainder of this chapter discusses previous studies of multiple program participation. Chapter 2 describes the selection of States for the study and the characteristics of the data. Chapter 3 describes methods of record linkage in general and the specific procedures for record linkage used for this study. Results are presented in chapter 4 and conclusions in chapter 5.

Previous Studies

The prevalence of shared clientele is well-documented for some social service programs. USDA has reported the percent of FSP participants receiving Aid to Families with Dependent Children/Temporary Assistance for Needy Families (AFDC/TANF), in the *Characteristics of Food Stamp Households* reports, since 1975. The Department of Health and Human Services (HHS) monitors multiple program participation in AFDC/TANF, the Food Stamp Program (FSP), and Supplemental Security Income (SSI) as part of a larger effort to report to Congress on indicators of welfare dependency.[7]

USDA estimates of the prevalence of AFDC/TANF participation among food stamp households are based on administrative data from the food stamp quality control system. These data measure contemporaneous multiple program participation and show that between 38 and 42 percent of food stamp households also received AFDC/TANF in the years from 1975 through 1995. After passage of welfare reform in 1996, the percentage of FSP households also receiving TANF declined to 35 percent in 1997, 27 percent in 1999, and 21 percent in 2002.

Participation in FSP by AFDC/TANF participants is more common than participation in AFDC/TANF by FSP participants. Indicators of multiple program receipt from HHS, based on the Current Population Survey, show the percentage of AFDC/TANF recipients also receiving food stamps ranged from 88 to 90 percent in the early 1990s and then declined (US DHHS, 2001).[8] In 1999, 83 percent of TANF recipients also received food stamps while only 29 percent of FSP participants received TANF.[9] The percentage of the total U.S. population receiving both AFDC/TANF and food stamps declined from 4.8 percent in 1993 to 2.4 percent in 1999.

Research on the dynamics of program participation, through the early 1990's, focused on AFDC/TANF or food stamps separately, rarely considering their interaction.[10] Greater attention focused on the interaction of programs after passage of welfare reform in 1996 when administrative data showed large declines in shared clientele and unanticipated declines in FSP participation overall (USDA/FNS, 2003b). The interaction of AFDC/TANF and FSP derives in part from an integrated application process found in most States.[11] Even after welfare reform, individuals applying for cash

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[7] The Welfare Indicators Act of 1994 (Pub. L. 103-432) directed the Secretary of HHS to publish an annual report on welfare dependency. An advisory board identified 10 indicators of welfare dependence, including the indicator "Multiple Program Receipt" (US DHHS, 2000).

[8] The Current Population Survey asks respondents about program participation during the past year.

[9] Estimates from USDA and HHS differ slightly because USDA estimates are based on Food Stamp Quality Control Data (a sample of administrative records), while HHS estimates are based on survey data.

[10] For example, Blank and Ruggles (1993) examined the duration of participation spells and triggers for program entry and exit but examined AFDC and food stamps separately.

[11] The information systems for food stamps and TANF are integrated in 39 States (US DHHS, 2003).

assistance (TANF) typically apply for a full package of benefits, including food stamps and Medicaid (Holcomb, et al., 2003). A number of studies examining the impact of the AFDC-to-TANF transition on FSP caseloads found evidence that TANF policies (reporting requirements, time limits, and sanctions) contributed to FSP caseload declines (Ziliak, Gunderson, and Figlio, 2000; Wallace and Blank, 1999; Gleason et al., 2001; Kornfeld, 2002; Currie and Groger, 2001).

There is little research concerning the prevalence of multiple program participation among the food assistance programs and this study addresses that gap. The main focus of this study is examination of the prevalence of participation in both the food stamp and WIC programs, the timing of participation across programs, and the characteristics of persons most likely to enroll in multiple programs.

In addition to examining the characteristics of multiple program participants, at least two other reasons have been cited for examining shared clientele among the FANPs, but they are not addressed in this study. First, it has been hypothesized that WIC caseload growth in the 1990s may have been influenced by decreased access to food stamps (Lee, et al., 2003). Second, concern has been expressed that increases in overweight and obesity among young children may be due to an abundance of food assistance (Besharov, 2002). All of these reasons for examining multiple program participation are motivated by the fact that the individual programs operate independently, and the combined provision of food assistance to households is not well understood. [12]

Income eligibility rules for the food assistance programs imply shared clientele. Income cutoffs for program eligibility are 130 percent of poverty for FSP, 185 percent of poverty for WIC, and 130 and 185 percent of poverty for free and reduced-price lunch, respectively. The extent of shared clientele, however, is limited by non-income eligibility criteria. While FSP enrolls persons of all ages, NSLP enrolls only school-age children, and WIC enrolls only pregnant and postpartum women, infants, and children up to age five. Eligibility criteria for FSP and WIC are shown in table 1.

Currently there are no administrative mechanisms to provide USDA with accurate and ongoing statistics on multiple program participation across the FANPs. Evidence of shared clientele in FSP and WIC is available from three sources − WIC administrative data, survey data, and record linkage studies − but all sources are known to have limitations.

WIC administrative data identify participants who are adjunctively income eligible due to participation in FSP, TANF, or Medicaid. Due to several reasons, however, estimates of multiple program participation based on adjunct income eligibility are lower bound estimates. Adjunct income eligibility may not be used in all cases for which it is applicable. Applicants to WIC may report only one adjunct program when they participate in more than one, because verification of one program is sufficient to establish WIC eligibility (or some local WIC agencies may be unable to enter all adjunct programs into their computer systems). And finally, WIC adjunct income eligibility is recorded at certification and does not reflect enrollment in adjunct programs after WIC certification.

Survey data also have limitations. Survey data have been found to underestimate program participation for single programs compared to administrative record counts. Data from the Survey of

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[12]   While operating independently, there are three main examples of systematic interaction between the FANPs: 1) WIC refers applicants to other social service programs, including FSP; 2) children in FSP households may be directly certified for NSLP without application; and 3) FSP participants are adjunctively income-eligibility for WIC.

Table 1 – Eligibility for FSP and WIC

Program	Eligibility criteria
Food Stamp Program	1) Income eligibility standards: ▪ Household **gross** income may not exceed 130 percent of the federal poverty guidelines; and ▪ Household **net** income may not exceed 100 percent of the federal poverty guidelines for households without an elderly or disabled member. Where gross income includes income from all sources; net income equals gross income less applicable deductions (the standard deduction, earned income deduction, dependent care deduction, excess medical expense deduction, shelter deduction, child support deduction). 2) Resource limit: a household otherwise eligible to participate is not eligible if resources exceed $2,000; or $3,000 if the household contains a member who is 60 years of age or older (certain resources are not counted such as a home and certain vehicles).
WIC Program	Four eligibility criteria: 1) Residency requirement in State where application is made. 2) Categorical eligibility for five groups: ▪ Pregnant women up to 6 weeks postpartum; ▪ Breastfeeding women up to 1 year after childbirth; ▪ Non-breastfeeding women up to 6 months after childbirth; ▪ Infants up to one year old; ▪ Children age one through four years (up to fifth birthday). 3) Income eligibility: family income less than or equal to 185 percent of the federal poverty guidelines or enrolled in Food Stamps, TANF, or Medicaid.[1] 4) Nutritional eligibility if applicant is determined to be at nutritional risk.

Sources: Food Stamp regulations: 7 CFR 273.9; WIC regulations: 7 CFR 246.7.

[1] Food stamp and TANF income eligibility thresholds are below the WIC income cutoff of 185 percent of poverty. Medicaid eligibility thresholds may exceed 185% for pregnant women, infants, and children in some States due to the following provisions (NGA, 2001 and 2003):

1) The Federally mandated Medicaid eligibility threshold for pregnant women, infants and children through age 6 is 133 percent of poverty. States have the option to expand coverage beyond federal mandates. As of October 2002, the Medicaid eligibility threshold was above the WIC threshold of 185% of poverty for pregnant women in 13 States; for infants in 13 States; and for children under age 5 in 5 States. Two of the three States in this study have Medicaid eligibility above 185% poverty, with eligibility at 200% of poverty for pregnant women and infants in Iowa, and for infants in Florida.

2) Medicaid regulations require States to provide pregnant women and infants with continuous eligibility in Medicaid regardless of fluctuations in income that would otherwise make them ineligible, for 60 days. Some States provide continuous eligibility past the 60-day mandate. Florida Medicaid provides 12 months of continuous eligibility for children under age 5; Iowa Medicaid provides12 months of continuous eligibility for pregnant and postpartum women and infants; Kentucky Medicaid provides 12 months deemed eligibility for infants when the mother is eligible at infant's birth (NGA, 2001 and 2003).

Income and Program Participation (SIPP) showed that participation in most programs is underestimated by 10 to 15 percentage points, and WIC participation is underestimated by 15 to 30 percentage points (Trippe, 2000). For programs with comparable underreporting, SIPP data provide reasonable estimates of multiple program participation. But due to differential underreporting of WIC, SIPP may be more useful for determining the percent of WIC participants receiving FSP, than for estimating the percent of FSP participants receiving WIC.

Record linkage studies, such as the current study, provide highly accurate estimates of multiple program participation by linking administrative data. They also have the advantage of providing longitudinal data for examination of the precise timing of participation across programs. The main limitations of record linkage are the difficulty in obtaining administrative data for research purposes

and the cost of processing large administrative files.[13] These costs are not large when compared with survey costs, but it is unlikely that record linkage can be used to provide nationally representative estimates due to the logistics of coordinating with many States' agencies. Nonetheless, record linkage studies provide evidence of the statistics that could become available with greater integration of administrative databases.

Despite the limitations of the data, WIC administrative counts of adjunctively income eligible participants are useful for examining trends in multiple program participation over time. These data show a decline in the percent of WIC participants with reported participation in FSP, from 46 percent in 1988, to 37 percent in 1994 and 1996, 27 percent in 1998, and 20 percent in 2000 (Williams, et al., 1990; Randall, et al. 1995 and 1998; Bartlett, et al. 2000 and 2002).[14] Only the 1988 data are reported separately by category of WIC participant: WIC children had the highest rate of FSP participation, at 52 percent.

Survey data show rates of multiple program participation in WIC and FSP that are somewhat higher than indicated by WIC administrative data (consistent with the limitations of the administrative data). Estimates from the National Health and Nutrition Examination Survey (NHANES-III, 1988-94) and SIPP (1993-95) show that 60 percent of WIC children also received food stamp benefits (Burstein, et al., 2000). Multiple program participation in FSP, WIC, and the National School Lunch and School Breakfast Programs, as indicated by SIPP and the Current Population Survey (CPS), is monitored by the USDA Food and Nutrition Service but is not publicly available.[15]

To our knowledge, there is only one previous record linkage study examining rates of multiple program participation in FSP and WIC. Lee et al. (2003) examined rates of participation in AFDC/TANF, FSP, and WIC for Illinois birth cohorts.[16] From 1990 to 1996, the percent of birth cohorts participating in both FSP and WIC at any time before their second birthday rose gradually and then declined (25.5 percent in 1990, 27.9 percent in 1993, 25 percent in 1996). At the same time, the percent of birth cohorts participating in WIC only (no FSP participation) was constant during 1990-93 (21-22 percent) and then rose to 27.7 percent in 1996. The declining rate of FSP participation among WIC participants from 1994-96 preceded, but is consistent with, the trend in national WIC data.[17]

The current study is similar to Lee et al. (2003) in using linked administrative data to examine shared clientele between the FSP and WIC programs. This study, however, examines data from three States for a later time period (January 2000 – December 2002) and includes both women and children.

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[13] Administrative data also typically have fewer measures of individual and household characteristics for studying the covariates of program participation.

[14] Bartlett et al. (2002) reports the rate of FSP participation by WIC enrollees may be biased because: a) 7.2 percent of WIC enrollees were missing data on adjunct program participation (i.e., the "yes/no" fields were blank); and b) there may be limits on the number of adjunct programs entered into computer systems by local WIC staff.

[15] Correspondence from USDA, Food and Nutrition Service, Office of Analysis, Nutrition and Evaluation.

[16] The study was funded by the Small Grants Program of USDA's Economic Research Service.

[17] The percent of young WIC participants (age birth to 2-years-old) also participating in FSP was 56.8 percent in 1992, 53 percent in 1994, and 47.4 percent in 1996. (Authors' derivations from Lee et al., table 2).

Chapter Two

Data

This chapter describes the selection of States for the study and the characteristics and contents of the administrative databases. The characteristics of the data are presented in detail, consistent with study goals to examine the feasibility of record linkage and consider the potential limitations of administrative data. Procedures for standardizing and cleaning the data prior to record linkage are also documented.

Selection of States for the Study

This study collected administrative data extracts from FSP and WIC programs in three States (Florida, Iowa, and Kentucky). These three States were selected based on the contents of their administrative databases, as reported during the Phase 1 survey conducted for this project. Two criteria were used to select States:

- **Common identifiers.** FSP and WIC client databases each had to have four common individual identifiers as *required* data fields in their client database: name, address, date of birth, and either Social Security Number (SSN) or phone number. A *required* data field is a field that is not supposed to be blank.

- **Record retention.** Participant records must be available for a three-year period, from January 2000 through December 2002. We preferred not to ask States to provide data from offline archives, to minimize burden.

The first criterion was used because individual identifiers such as name, date of birth, SSN, address, and phone must be present to establish a match across files. The presence of four identifiers gave us the flexibility to examine record linkage results under different matching scenarios, defined by the number of match variables. The second criterion was chosen arbitrarily so that we would have "enough" data to examine patterns of participation across the two programs over time.

Among the 26 States surveyed in Phase 1 of the study, only four States met the first criterion: FSP and WIC programs each have name, address, date of birth, and SSN in their client databases as required data fields. These States include the three participating in the study (Florida, Iowa, and Kentucky) plus Tennessee.[18] There were no surveyed States in which both FSP and WIC databases have name, address, date of birth, and phone as required data fields.[19] Table 2 shows all personal identifiers reported to be in the participant databases for the three selected States.[20]

Online record retention varied across the FSP and WIC programs in the three States selected for the study. FSP and WIC programs operate under federal regulations requiring record retention for a minimum of three years (7 CFR 275.4; 7 CFR 246.25), but offline archival can be used to satisfy those requirements. Kentucky FSP and WIC programs reported that client records are never taken

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[18] Tennessee was chosen to participate in the study, but the Food Stamp Program was unable to provide data.

[19] Eight additional States met relaxed criteria such that name, address and date of birth are required for FSP and WIC; SSN is required for FSP and available but not required for WIC; and phone number is available but not necessarily required by either FSP or WIC.

[20] In FSP files, address appears on the records of household heads, but can be linked to each household member.

Table 2—Personal identifying information reported to be in FSP and WIC information systems

	First name	Last name	SSN	Date of birth	Address	Mailing address	Phone number	County	Gender	Race/ethnicity	Primary language	Date of first certification	Start & end dates of each cert. period	Monthly indicators of participation	WIC Only Food Stamp case number	WIC Only TANF case number	WIC Only Medicaid case number
Florida																	
Food Stamp Program																	
Household head	✔	✔	✔	✔	✔	❑	❑	✔	✔	✔	✔	❑	❑	❑			
Other family members	✔	✔	✔	✔	—	—	—	—	✔	✔	—	—	—	—			
WIC Program																	
Women	✔	✔	✔	✔	✔	❑	❑	✔	✔	✔	—	✔	✔	—	❑	❑	❑
Infant/child	✔	✔	✔	✔	✔	❑	❑	✔	✔	✔	—	✔	✔	—	❑	❑	❑
Iowa																	
Food Stamp Program																	
Household head	✔	✔	✔	✔	❑	✔	❑	❑	❑	❑	—	✔	❑	—			
Other family members	✔	✔	✔	✔	❑	✔	❑	❑	❑	❑	—	✔	❑	—			
WIC Program																	
Women	✔	✔	✔	✔	✔	—	❑	✔	✔	✔	✔	—	✔	✔	—	—	—
Infant/child	✔	✔	✔	✔	✔	—	❑	✔	✔	✔	✔	—	✔	✔	—	—	—
Kentucky																	
Food Stamp Program																	
Household head	✔	✔	✔	✔	✔	❑	❑	✔	✔	✔	✔	✔	✔	✔			
Other family members	✔	✔	✔	✔	—	—	—	—	✔	✔	✔	✔	✔	✔			
WIC Program																	
Women	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	—	✔	✔	✔	—	—	—
Infant/child	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	—	✔	✔	✔	—	—	—

✔ Indicates data field is required to be filled; ❑ indicates data field is available but not required to be filled; — indicates data field is not available.

Source: *Survey of Food Assistance Information Systems*, Abt Associates, 2002.

offline. Florida FSP and WIC programs take records offline after cases have been inactive for 21 and 30 months, respectively. Iowa FSP and WIC programs take records offline after cases have been inactive for 24 and 66 months, respectively. All programs were asked to provide extracts containing persons active at any time during the three-year period from January 2000 to December 2002. Only Kentucky FSP was unable to provide data for the three-year period and instead provided data for one month (December 2002). It took several months for some State programs to fill the data request. Original requests were made in November 2002 and all data extracts were received by May 2003.

In addition to record retention policies, overwriting policies for individual data fields are relevant when collecting data retrospectively and linking data across systems. For example, when a person's name changes due to marriage, divorce, or adoption, some systems retain the old name in a separate data field, or history file, and some systems overwrite the old data. If a person is active in FSP and WIC at the same point in time, but enrolled at different points in time, then some identifying information may not match. The Phase 1 survey identified only one State (Kentucky) where both FSP and WIC data systems do not overwrite four identifying fields: name, date of birth, SSN, and address. The overwriting/retention rules reported in the Phase 1 survey for the selected States are shown in table 3.

The three selected States vary in caseload size. Table 4 shows FSP and WIC caseload information reported by USDA for the three States in the study. Florida is by far the largest with 5.1 percent of total U.S. food stamp participants and 4.3 percent of total U.S. WIC participants. Iowa has less than one percent of total FSP and WIC participants. Kentucky has 2.4 and 1.5 percent of total FSP and WIC participants, respectively.

Characteristics of Administrative Data Extracts

This section describes the characteristics of FSP and WIC data extracts, in terms of file size and format, records selected for matching, data elements, data quality, and participant dynamics within program over the three-year period. FSP and WIC programs in Florida and Iowa provided data for all persons participating in their program at any time during the period January 2000 through December 2002. Kentucky WIC also provided data for the three-year period, while Kentucky FSP provided data for one month (December 2002).

Table 3 – Overwriting and retention rules for personal identifying information in FSP and WIC programs in selected States

State	Program	Overwriting and retention of Name, Date of birth, SSN, Address, Telephone number[a]
Florida	FSP	Retain all except date of birth
	WIC	Overwrite all
Iowa	FSP	Overwrite all
	WIC	Overwrite all
Kentucky	FSP	Retain all except telephone number
	WIC	Retain all

[a]   Indicates whether old information is retained in separate data field when change is made, or whether old information is overwritten and lost.

Source: Cole, Nancy. *Feasibility and Accuracy of Record Linkage To Estimate Multiple Program Participation: Volume I, Record Linkage Issues and Results of the Survey of Food Assistance Information Systems,* E-FAN-03-008-1.

Table 4 – Number of participants in FSP and WIC programs in three selected States

State	Food Stamp Program[a]		WIC[b]	
	Number of participants	Percent of U.S. total	Number of participants	Percent of U.S. total
Florida	888,000	5.1	340,601	4.3
Iowa	124,000	0.7	62,798	0.8
Kentucky	418,000	2.4	121,098	1.5
U.S. Total	17,297,000	100.0	7,855,537	100.0

[a]   Source: *Characteristics of Food Stamp Households: Fiscal Year 2001* (USDA, 2003).
[b]   Source: *WIC Participant and Program Characteristics 2000* (Bartlett et al., 2002).

File size and format

The characteristics of the data files are shown in table 5, and the number of unique persons in those files is shown in table 6 (first column). Most data files were provided as flat file ASCII files, except Florida WIC data were in MS-Access format. Within program, file size varied across States according to caseloads. Within Florida and Iowa, FSP files were larger than WIC files due to larger caseloads and different record structure. The FSP files contained records for the entire caseload, even though only records for women of childbearing age, infants, and children would be matched to WIC data.

FSP data files contained one record per participant per month, while WIC data files contained one record per participant per certification.[21] This difference has two implications. First, identification of FSP participants in a given month was straightforward using the "year/month" indicator that was present on the file, while identification of WIC participants in a given month was based on certification date together with length of certification period.[22] The second implication is that FSP files identified participants who received benefits in a given month, whereas WIC files identified enrollees regardless of whether they picked up benefits for a particular month. The distinction between enrollees and participants is not considered important for this study because much of the analysis examined persons participating in FSP or WIC at any time during the three-year period.[23]

Data files from Florida, the largest of the three States, were nearly 10 times larger than data files from Iowa, the smallest State (measured by approximate file size). Florida FSP data consisted of over 30 million person-month records for 2.6 million participants during the three-year period, and the data occupied over 8 gigabytes of disk space. In contrast, data from the Iowa FSP program consisted of nearly 2.5 million person-month records for 337 thousand participants, and occupied less than one gigabyte of disk space.

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[21]   WIC certification records are also used in the USDA, Food and Nutrition Service biennial *Studies of WIC Participant Characteristics*.

[22]   Most WIC applicants are certified for 6-month periods, except infants are certified up until their first birthday.

[23]   As discussed later, when FSP files showed a one-month break between two spells of participation, FSP participation was imputed to provide a continuous spell. The elimination of these spurious breaks in participation makes the FSP data more comparable to WIC enrollment data.

Table 5—Administrative data files received from FSP and WIC programs

	File format	Period	Approx. file size	Total number of records[1]
Florida				
Food Stamp Program	ASCII	3 years	8 gigabytes	32,802,926
WIC Program	MS-Access	3 years	515 MB	1,933,424
Iowa				
Food Stamp Program	ASCII	3 years	883 MB	2,451,181
WIC Program	ASCII	3 years	59 MB	362,494
Kentucky				
Food Stamp Program	ASCII	1 month	75 MB	474,685
WIC Program	ASCII	3 years	121 MB	684,999

[1] Number of records in FSP files is equal to number of person-months during 3-year period. Number of records in WIC files is equal to number of certifications during 3-year period.

Table 6—Analysis samples

	Total number of persons[1]	Women, Infants, and Children (W-I-C)[2]	
		All persons active 2000-2002	Active caseload in December 2002
Florida			
Food Stamp Program	2,621,488	1,194,425	388,817
WIC Program	981,464	981,464	403,477
Iowa			
Food Stamp Program	337,083	180,171	60,345
WIC Program	163,649	163,649	70,239
Kentucky			
Food Stamp Program	474,685	na	200,013
WIC Program	329,785	329,778	131,174

[1] FSP count of persons includes entire caseload and is not limited to women, infants, and children.
[2] W-I-C in FSP caseload are identified by age: women of childbearing age (15-45), infants, and children up to age 5.
na = not available.

Analysis samples

Table 6 shows the number of unique persons in each data file, and the number of unique persons in the analysis samples. Figure 4 provides a flowchart from the original data files to the analysis files, using Florida as the example. Two main steps are shown in the flowchart: data reduction (FSP and WIC) and selection of subgroups (FSP only). The original FSP data files were reduced from one record per person per month to one record per person with an array of monthly participation indicators. Similarly, WIC files were reduced from one record per certification to one record per person with an array of certification dates.[24]

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[24] This is a simplified characterization of the data reduction; a more detailed discussion appears in chapter 3.

Figure 4 – Flowchart of data processing and selection of analysis samples
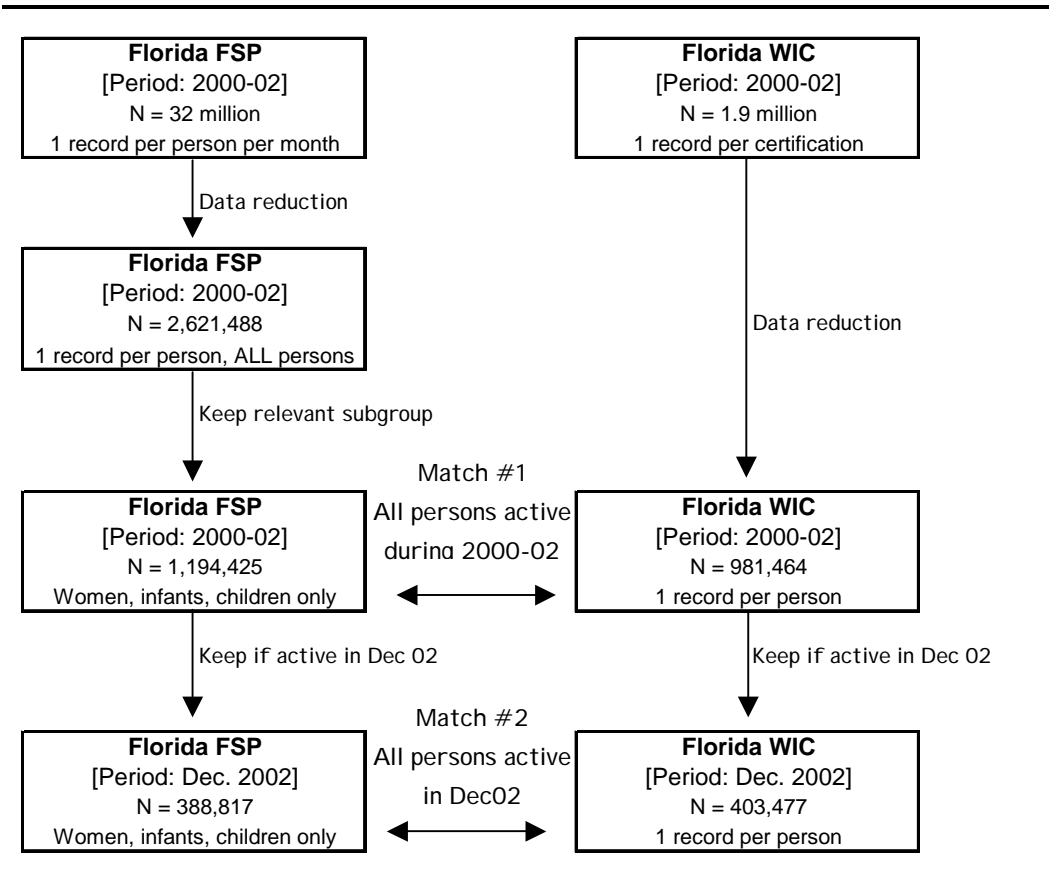
The analysis samples include all WIC participants and the subset of FSP participants identified as women of childbearing age (15-45 years old), infants, or children up to age 5 (hereafter referred to as W- I-C). All WIC participants are used for matching even though only persons with income not exceeding 130 percent of the federal poverty level are potentially eligible for FSP, subject to resource limits (see table 1). This subset of WIC participants cannot be identified with precision, however, because definitions of household and household income vary between FSP and WIC. In addition, the availability of income data in WIC administrative databases varies among States.[25] For these reasons, a subset of records was not selected from WIC databases prior to matching.

Two analysis samples were used: 1) W-I-C who were active at any time during 2000-2002, and 2) W-I-C who were active in December 2002. These samples are denoted "Match #1" and "Match #2" in figure 4. December 2002 was chosen because data from Kentucky FSP were received for that month only.

Table 7 provides a count of women, infants, and children included in the matching routines from the December 2002 caseloads of each State. W-I-C represent 38 to 45 percent of *total* FSP caseloads and

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[25]   The biennial census of WIC participants reported in *WIC Participant and Program Characteristics 2000* found that income was reported on the records of only 87 percent of WIC participants in April 2000. Administrative records from seven States (including Kentucky) had income missing for over 30 percent of WIC participants.

Table 7—Number and percent of women, infants, and children (W-I-C) in FSP and WIC caseloads, December 2002

	Food Stamps		WIC	
	Number	Percent of total caseload	Number	Percent of total caseload
Florida				
Total W-I-C	388,817	38.19	403,477	100.00
Women				
Age 15-18	33,379	3.28	10,214	2.53
Age 19-34	122,500	12.03	78,815	19.53
Age 35-45	71,677	7.04	9,577	2.37
Total	227,556	22.35	98,606	24.44
Infants	29,953	2.94	112,352	27.85
Children				
Age 1	34,030	3.34	63,476	15.73
Age 2	33,712	3.31	50,384	12.49
Age 3	32,066	3.15	42,822	10.61
Age 4	31,500	3.09	35,837	8.88
Total	131,308	12.90	192,519	47.71
Iowa				
Total W-I-C	60,345	45.03	70,239	100.00
Women				
Age 15-18	4,085	3.05	1,745	2.48
Age 19-34	22,348	16.68	14,171	20.18
Age 35-45	10,782	8.05	1,069	1.52
Total	37,215	27.77	16,985	24.18
Infants	4,655	3.47	17,227	24.53
Children				
Age 1	4,781	3.57	11,650	16.59
Age 2	4,764	3.56	9,242	13.16
Age 3	4,660	3.48	8,232	11.72
Age 4	4,270	3.19	6,903	9.83
Total	18,475	13.79	36,027	51.29
Kentucky				
Total W-I-C	200,013	42.14	131,174	100.00
Women				
Age 15-18	16,205	3.41	3,895	2.97
Age 19-34	75,515	15.91	27,246	20.77
Age 35-45	37,539	7.91	1,597	1.22
Total	129,259	27.23	32,738	24.96
Infants	14,016	2.95	33,965	25.89
Children				
Age 1	14,384	3.03	21,261	16.21
Age 2	14,526	3.06	16,463	12.55
Age 3	14,149	2.98	14,122	10.77
Age 4	13,679	2.88	12,625	9.62
Total	56,738	11.95	64,471	49.15

100 percent of WIC caseloads. FSP enrolls more women of childbearing age than WIC (because FSP enrolls women who are not pregnant or postpartum). WIC enrolls more infants and children than FSP. The ratio of WIC infants to FSP infants varied across States: 3.7 in Florida and Iowa, and 2.4 in Kentucky. The ratio of WIC children to FSP children also varied across States: 1.5 in Florida, 2.0 in Iowa, and 1.1 in Kentucky. These differences are consistent with different Medicaid eligibility provisions, which affect WIC enrollment through WIC adjunct income eligibility.[26]

The number of records entering the matching routine exceeds the number expected to match, for four reasons. First, FSP women of childbearing age include women not eligible for WIC because they are not pregnant or postpartum. Pregnant women cannot be identified in the FSP data and postpartum women may be identified with error if the mother-infant pair does not reside together or if there is a lag in enrolling the infant in the FSP. Second, all FSP W-I-C are income-eligible for WIC, but they may not necessarily meet WIC nutritional risk criteria. Third, some WIC participants across all categories of W-I-C are not eligible for FSP because their income exceeds 130% of poverty (WIC eligibility threshold is 185% of poverty).[27] Fourth, some persons eligible for both programs will not be matched because they have decided to participate in only one program, even though they may be eligible for both.

The subsets of FSP records selected for matching were taken from caseloads that are described in table 8. This table shows the distribution of persons and households participating in FSP by household type, and the percent of persons from each household type that are potentially eligible for WIC. In all three States, approximately 40 percent of all FSP participants are in single-adult households with children. Infants and children under age five represent 15 to 17 percent of FSP participants, and women of childbearing age represent 22 to 27 percent. Children under 5 years of age are present in more than half of single-adult-households-with-children[28], and nearly 90 percent of those households contain women of childbearing age (not shown in table).

Data elements

The data elements provided in each data file are shown in table 9. Five main types of data elements were requested for each program participant: personal identifiers, contact information, program participation dates, household income, and indicators of participation in certain other public programs.

The three States participating in this study were purposefully selected based on the data fields present in their program databases. For the most part, table 9 coincides with table 2 (information reported to the Phase 1 survey). The data extracts from all programs contain first and last name, date of birth, SSN, gender, and race. All FSP programs provided information on participants' relationship to household head. All WIC programs provided certification category and guardian names for infants and children. Contact information includes street address, city, State, ZIP code, and phone number.

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[26] Florida and Iowa Medicaid eligibility for infants is 200% of poverty compared to 185% of poverty in Kentucky. Florida and Iowa have Medicaid continuous eligibility provisions, which may explain higher ratios of WIC to FSP children in those States. (See footnote to table 1.)

[27] In addition to income and asset limits, there are non-financial FSP eligibility restrictions – particularly those related to citizenship, residency, and immigration status – that might impact a WIC participant's eligibility for food stamps.

[28] Children under age five are 15.84 percent of the total Florida caseload and 8.69 percent of children under age 5 are in single-adult households: 8.69 / 15.84 = 55%.

Table 8—Distribution of persons and households participating in FSP by household type, December 2002

	Persons		Households		Percent of persons who are		Total percent potentially eligible for WIC
	Number	Percent	Number	Percent	Children under age 5	Women of child-bearing age	
Florida, Total	1,017,979	100.00	480,847	100.00	15.84	22.35	38.20
With children							
Single adult	427,853	42.03	135,425	28.16	8.69	13.16	21.85
Married couple	125,175	12.30	28,787	5.99	2.17	2.75	4.93
Multiple adults	90,695	8.91	20,112	4.18	1.73	2.57	4.30
Children only	80,700	7.93	39,156	8.14	3.24	0.51	3.75
Without children							
Single adult, elderly	109,431	10.75	109,431	22.76	0.00	0.00	0.00
Single adult, not elderly	113,826	11.18	113,826	23.67	0.00	2.71	2.71
Multiple adults, elderly	50,085	4.92	24,366	5.07	0.00	0.11	0.11
Multiple adults, not elderly	20,214	1.99	9,744	2.03	0.00	0.54	0.54
Iowa, Total	134,005	100.00	59,699	100.00	17.27	27.77	45.04
With children							
Single adult	59,548	44.44	20,421	34.21	10.28	15.17	25.46
Married couple	29,738	22.19	6,824	11.43	4.41	5.32	9.73
Multiple adults	10,036	7.49	2,331	3.90	1.55	2.17	3.71
Children only	3,443	2.57	2,051	3.44	1.03	0.39	1.42
Without children							
Single adult, elderly	7,295	5.44	7,295	12.22	0.00	0.00	0.00
Single adult, not elderly	17,775	13.26	17,775	29.77	0.00	3.83	3.83
Multiple adults, elderly	2,335	1.74	1,141	1.91	0.00	0.05	0.05
Multiple adults, not elderly	3,835	2.86	1,861	3.12	0.00	0.84	0.84
Kentucky, Total	474,685	100.00	198,176	100.00	14.91	27.23	42.14
With children							
Single adult	190,618	40.16	65,258	32.93	8.52	13.54	22.05
Married couple	113,939	24.00	27,530	13.89	3.97	6.06	10.03
Multiple adults	56,110	11.82	13,253	6.69	1.97	3.39	5.36
Children only	6,052	1.27	3,327	1.68	0.44	0.28	0.73
Without children							
Single adult, elderly	24,228	5.10	24,228	12.23	0.00	0.00	0.00
Single adult, not elderly	47,089	9.92	47,089	23.76	0.00	2.52	2.52
Multiple adults, elderly	14,163	2.98	6,800	3.43	0.00	0.11	0.11
Multiple adults, not elderly	22,486	4.74	10,691	5.39	0.00	1.34	1.34
U.S. Average, FY2001[1]	17,300,000	100.00	7,450,000	100.00	16.64	27.32	43.96
With children							
Single adult	8,494,000	41.65	2,690,000	31.74	–	–	–
Married couple	2,658,000	13.03	572,000	6.75	–	–	–
Multiple adults	1,426,000	6.99	325,000	3.84	–	–	–
Children only	831,000	4.08	405,000	4.78	–	–	–
Without children							
Single adult, elderly	1,220,000	5.98	1,220,000	14.40	–	–	–
Single adult, not elderly	2,017,000	9.89	2,017,000	23.80	–	–	–
Multiple adults, elderly	712,000	3.49	300,000	3.54	–	–	–
Multiple adults, not elderly	3,034,000	14.88	945,000	11.15	–	–	–

[1] Source: USDA, Food and Nutrition Service. *Characteristics of Food Stamp Households: Fiscal Year 2001,* Alexandria, VA: 2003.
From this source, the sum of individual categories does not match the table total because participants and households were counted in multiple categories.
– Data not available.

Table 9—Data elements in the FSP and WIC administrative data extracts

	Food Stamp Programs			WIC Programs		
	Florida	Iowa	Kentucky	Florida	Iowa	Kentucky
Personal identifiers						
Participant ID	✔	✔	(1)	✔	✔	✔
Case number	✔	✔	✔			
First name	✔	✔	✔	✔	✔	✔
Last name	✔	✔	✔	✔	✔	✔
Middle initial			✔		✔	✔
Date of birth	✔	✔	✔	✔	✔	✔
Social Security Number (SSN)	✔	✔	✔	✔	(2)	✔
Sex	✔	✔	✔	✔	✔	✔
Race code	✔	✔	✔	✔	✔	✔
Language			✔		✔	
Relationship to household head	✔	✔	✔			
Certification category				✔	✔	✔
Contact information						
Address						
Street	✔	✔	✔	✔	✔	✔
City	✔	✔	✔	✔	✔	✔
State	✔	✔	✔	✔	✔	✔
Zip code	✔	✔	✔	✔	✔	✔
Phone	✔	(3)	✔	✔	✔	✔
County (office) code	✔	✔	✔	✔	✔	✔
Dates of program participation						
Month/Year indicator	✔	✔	(1)			
Certification date				✔	✔	✔
Certification end date				✔		
WIC family information						
Family ID				✔		
Guardian first name				✔	✔	✔
Guardian last name				✔	✔	✔
Guardian middle initial						✔
Income						
Family (household) size	✔	✔	✔	✔	✔	✔
Income		✔	✔	✔	✔	✔
Participation in other programs						
Food Stamps				✔	✔	✔
Medicaid		✔		✔	✔	✔
TANF				✔	✔	✔
Cash assistance	✔	✔	✔			
FSP/TANF/Medicaid ID	✔			✔		

✔   Indicates data element is present.
(1)   These fields were not needed because Kentucky FSP provided only one month of data.
(2)   SSN is not a separate data field. Participant ID contains own SSN (women) or mother's SSN (infants/children), if available. Else the participant ID contains the day and year that the record was entered in the system.
(3)   Phone numbers do not include area code.

Information about participation in certain other programs is present in both FSP and WIC client databases. The FSP programs in all three States are integrated with TANF, providing a reliable indicator of cash assistance on each person-month record. Iowa FSP records also include an indicator of Medicaid participation. WIC programs are not integrated with other public assistance programs, but their databases contain indicators of adjunct income eligibility (participation in TANF, FSP, or

Medicaid) because applicants may be certified without income documentation if they document participation in these means-tested programs. As noted earlier, indicators of adjunct income eligibility may underestimate actual rates of participation in each program because reporting of one program is sufficient to establish WIC eligibility, even if persons participate in more than one adjunct program. In addition, these indicators capture participation in adjunct programs at the time of WIC certification but do not reflect enrollment in adjunct programs after WIC certification.

FSP and WIC data systems each assign unique participant IDs to individuals. These IDs provide a link between records over time within each system.[29] An additional identifier in the FSP is the participant's case number, identifying the household unit that applied to the program. FSP participants may, however, be associated with multiple case numbers over time if the composition of the household changes. Usually there is a change in case number when there is a change in household head. Some of the analysis presented in chapter 4 excludes "complicated" households containing individuals who changed case number during the study period.[30]

The FSP case number provides a link among FSP household members. In contrast to the FSP, which enrolls households, WIC enrolls individuals. Even so, some WIC programs assign a family ID in addition to a participant ID for use in appointment scheduling and other administrative functions (see Cole, 2003). Among the three WIC programs in this study, only Florida assigns a family ID. As shown in table 9, WIC records for infants and children contain a guardian name that could be used to link family members, but this link was not needed for the analysis presented in this report.[31]

Personal identifiers include first and last name, date of birth, SSN, gender, and race. These data items were the primary items used to link records from FSP and WIC. All identifiers except last name are expected to be stable over time, except for data entry errors or use of abbreviations or nicknames for the first name. Last names may change over time due to marriage, adoption, or divorce.

Contact information consists of components of the address field, telephone number, and county. Contact information is not necessarily stable over time, but it is helpful in linking contemporaneous records from two different data files.

Dates of program participation identify the active caseload at a point in time, and were used to examine the dynamics of program participation and multiple program participation. As discussed above, FSP files contain one record for each active participant each month. Each record has a "year/month" indicator. WIC data contain one record per certification period, and each record contains a certification date. The Florida WIC program also provided the "certification end date" in their data file even though it was not a requested data field; certification end dates were imputed for Iowa and Kentucky based on certification date and program rules. The certification date start and end dates can be used to identify the active caseload at a point in time.

The contents of data extracts are consistent across programs, with the following exceptions:

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[29] Some WIC programs have participant IDs that are unique within the local agency, but not unique within the State. In these States, participant IDs change when participants move and transfer to a new agency and the link between longitudinal records is broken (Cole, 2003). Florida, Iowa, and Kentucky assigned unique IDs within the State.

[30] The percent of W-I-C in "complicated households" was 6 percent in Iowa and 8 percent in Florida.

[31] Mother-child pairs could be linked by mother's name and guardian names; siblings could be linked by guardian names.

- Language: Available from only two programs and was not used in matching routines.
- SSN: Iowa WIC does not have SSN in a separate data field. If SSN is provided by an applicant, it is used as part of the participant ID; however, a mother's SSN may be used as part of her child's participant ID. SSNs were extracted from participant IDs for women, but not for infants and children.
- Telephone: Iowa FSP did not include area code.[32]
- Family ID: Kentucky and Iowa WIC do not maintain a family ID.[33]
- Income: Florida FSP did not provide income.
- WIC dates: Florida was the only program to provide certification end dates; these dates were imputed for the other two programs.
- Adjunct ID: Florida WIC was the only WIC program to maintain the FSP/TANF/Medicaid ID number in addition to indicators of participation in those programs. This data field was not used in the record linkage routines, but was used in examining the results of record linkage.

Quality of participant data

Data files were evaluated for prevalence of missing data and standardization of address fields. Missing data are indicated by blank fields or fields filled with zeros or nines. Standardization implies that the same data appears identically within the data file. For example, city names might be standardized at data entry by choosing cities from a list rather than keying in city names, thus eliminating spelling variations.

Examination of the December 2002 caseloads showed that FSP and WIC files in all three States had no missing data for participant names and virtually no missing data (less than .01 percent) for date of birth and gender. Race was almost never missing on WIC records and was missing on less than 2 percent of FSP records. Each of the address components (street address, city, and ZIP code) was missing on less than 2 percent of FSP and WIC records.[34]

The data fields subject to quality problems are shown for FSP and WIC in tables 10 and 11, respectively. SSN and telephone number were subject to missing data; city was not standardized; and

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[32]   Iowa FSP and WIC data were matched using telephone number without area code. Iowa is divided into five area codes, however, so it was possible that telephone numbers in two different area codes would provide a false match. This was not considered a significant problem because telephone number was only one of several identifiers used for matching.

[33]   Florida reported that family IDs are reliable for "some currently participating family members" (Cole, 2003). Family IDs might not be reliable for linking family members whose participation was not contemporaneous.

[34]   It is difficult to accurately assess the amount of missing data for street addresses without geocoding the data, which was not done. Casual observation revealed that this data field was occasionally used for comments – for example, to indicate a contact person outside the family.

Table 10—Percent of FSP records with missing or non-standardized data, December 2002

	Number of records	Percent with missing data for		Percent with nonstandardized data for	
		SSN	Telephone	City	ZIP code
Florida					
Total FSP	388,817	1.3	6.2	10.3	0.3
Women	227,556	0.4	6.2	10.5	0.3
Infants	29,953	12.8	6.2	10.0	0.4
Children	131,308	0.3	6.0	10.1	0.3
Iowa					
Total FSP	60,345	1.2	12.9	2.7	0.1
Women	37,215	0.1	13.5	2.7	0.1
Infants	4,655	14.7	12.8	2.8	0.0
Children	18,475	0.2	11.7	2.8	0.1
Kentucky					
Total FSP	200,013	0.0	6.6	28.6	0.1
Women	129,259	0.0	6.4	29.1	0.1
Infants	14,016	0.0	7.3	27.8	0.1
Children	56,738	0.0	6.7	27.6	0.1

Table 11—Percent of WIC certification records with missing or non-standardized data, December 2002

	Number of records	Percent with missing data for		Percent with nonstandardized data for		Quality of income data	
		SSN	Telephone	City	ZIP code	Missing income	Income equal zero
Florida							
Total WIC	403,477	26.6	3.7	25.8	0.5	0.9	3.7
Women	98,606	13.7	3.6	29.2	0.6	0.8	4.3
Infants	112,352	71.4	3.7	22.1	0.6	1.2	4.9
Children	192,519	7.1	3.8	26.1	0.5	0.8	2.7
Iowa							
Total WIC	70,239	76.6	2.8	6.3	0.3	0.0	8.7
Women	16,985	3.0	2.7	6.4	0.3	0.0	12.5
Infants	17,227	100.0	2.7	6.2	0.3	0.0	12.3
Children	36,027	100.0	2.8	6.4	0.3	0.0	5.2
Kentucky							
Total WIC	131,174	11.0	4.1	31.8	0.8	43.1	14.7
Women	32,738	1.2	3.7	31.2	0.7	30.0	14.7
Infants	33,965	33.5	5.5	31.0	1.4	53.1	16.8
Children	64,471	4.2	3.6	32.5	0.6	44.4	13.6

Note: Iowa WIC does not have a separate data field for SSN. See text discussion.

WIC income data showed high percents of missing data or zero values. It is important to note, however, that records with missing data were included in the record linkage procedures. As explained in chapter 3, probabilistic record linkage uses all available information. Missing data in one or more data fields does not necessarily preclude a match.

SSN was never missing on Kentucky FSP records. For Florida and Iowa, SSN was missing on only 1 percent of FSP records overall, but on over 10 percent of infant records. FSP requires an SSN for certification, so it is likely that missing data reflects the delay in SSN issuance for newborns. WIC does not require SSNs for certification, which is reflected in higher rates of missing data compared with FSP. SSNs are missing across all WIC participant categories, although the highest rates are for infants.[35] The table shows that SSN is missing for all Iowa infants and children. As discussed above, Iowa WIC does not have a separate data field for SSN; SSN was extracted from the participant ID for women, but SSNs embedded in the participant ID of infants and children were not extracted because they were likely to be the mother's SSN.

Telephone numbers are potentially valuable for record linkage because they are long numeric fields that are unique to households. Missing telephone numbers are more common in FSP than WIC; 6 and 7 percent of FSP records in Florida and Kentucky, and 13 percent in Iowa are missing telephone number. Only 2 to 4 percent of WIC records are missing telephone number across the three States.

Tables 10 and 11 show the percent of city names and ZIP codes that are not standardized in the sense that they do not match exactly to a master list of place names (cities, towns, county divisions) and ZIP codes in the State.[36] Spelling variations in city names compromise the usefulness of these data for record linkage. For example, there are 960 place names in Florida but over 7,000 unique city names are in the WIC data files (e.g., over 40 spelling variations were recorded for Fort Lauderdale). Kentucky has the highest prevalence of non-standardized city names at 29 and 32 percent of FSP and WIC records, respectively. The percent of non-standardized city names in FSP and WIC was 10 and 26 percent in Florida, and only 3 and 6 percent in Iowa.

The lack of standardized city names was not consistent with responses to the Phase 1 survey: Florida and Kentucky FSP indicated that city and ZIP codes were standardized.[37] Because city names were not standardized, it was not clear that this data field should be used for matching. In addition, ZIP codes could be more useful for matching because they have more geographic precision than cities, which may contain multiple ZIP code areas. Nonetheless, it was thought to be beneficial to include both city and ZIP code in matching routines because potential errors in data are generated differently. ZIP code errors are most likely to result from transposition of numbers, resulting in a ZIP code that references the wrong city. On the other hand, city errors are unlikely to occur in the sense that the wrong city is referenced, but city names are subject to spelling errors and spelling variations.[38]

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[35]   Missing SSNs on WIC records may reflect enrollment of persons without access to SSNs, such as illegal aliens.

[36]   The master list of city names and ZIP codes was current as of September 2003, from the ZIPList5 database available from CD Light, LLC (zipinfo.com).

[37]   FSP and WIC programs in all three States indicated that ZIP codes are not validated (source: Phase 1 survey).

[38]   As discussed in chapter 3, city and ZIP codes were matched using different criteria with an exact match required for ZIP code but a string comparison (allowing for spelling variations) used for city.

Table 11 shows the quality of income data for WIC programs. The WIC income eligibility cutoff is higher than FSP eligibility limits, so income could potentially be used to select records from WIC files prior to record linkage. As shown in table 11, however, over 40 percent of Kentucky WIC records are missing income data, and a large percent of records in Iowa and Kentucky have zero income (9 and 15 percent, respectively).[39] As noted above, WIC records were not selected based on income prior to record linkage.

Availability of historical data for personal identifiers

In theory, the data files obtained for this study could provide estimates of the rate of change in household information over time (e.g., name changes due to marriage, divorce, adoption) and the rate of mobility (e.g., address and telephone changes) for FSP and WIC populations. In practice, however, the rates of change in individual identifiers depends on whether information systems overwrite or retain data, and the way in which data extracts are created.

Table 3 reported the overwriting and retention rules reported in the Phase 1 survey for name, date of birth (DOB), SSN, address, and telephone number. Iowa FSP, Iowa WIC, and Florida WIC reportedly overwrite all identifiers when information changes (thus losing old information, except in off-system archives). Florida FSP overwrites only DOB; Kentucky FSP overwrites only telephone number; and Kentucky WIC reported no overwriting.

Tables 12 and 13 show the availability and prevalence of historical changes in identifying information observed in the data. There are some inconsistencies between reported overwriting policies and actual data, which may be due to the methods used to create data extracts. Florida FSP data show no change in personal identifiers (even though there is reportedly no overwriting) and high rates of change in contact information. Iowa FSP data show near zero rates of change in personal identifiers (consistent with overwriting of all information) and high rates of change in contact information (not consistent with overwriting).[40]

WIC data from Florida and Iowa are consistent with the overwriting policies discussed above −these programs reportedly overwrite all data and the data files show no change in personal identifiers over time. Florida WIC shows small rates of change in contact information indicating a possible change in policy over time or an effort to standardize data.

Observed rates of change in personal identifiers are likely to be equal or close to true rates of change for Iowa FSP and Kentucky WIC. The rates of change are measured over a one-year period.[41]

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[39] Missing income data has been reported in the *WIC Participant and Program Characteristics* reports as associated with adjunct income eligibility (Bartlett et al., 2000 and 2002). However, adjunct income eligibility does not imply income below a single national cutoff because Medicaid eligibility thresholds vary by State and may exceed the WIC threshold of 185% of poverty. As of October 1, 2000, Medicaid eligibility was 200 percent of the poverty level for pregnant women and infants in Iowa, and for infants in Florida.

[40] Florida FSP provided person-level records and case-level records (contact information) in separate files and most likely lost the historic person-level information in the way that the data were extracted. Iowa FSP data extracts were created from month-end archives, thereby preserving the historical data.

[41] This analysis was based on the most recent 12 months of participation for FSP participants with at least 6 months of participation, and the two most recent certification records for WIC participants. Restricting the sample to a one-year period eliminates the potential downward bias if long-term participants are more stable than short-term participants.

Table 12—Availability and prevalence of historical changes in personal identifying information for FSP participants[1]

	Florida				Iowa			
	Total	Women	Infants	Children	Total	Women	Infants	Children
Number participants with > 6 months of participation	595,245	351,592	63,332	180,321	93,229	56,558	9,353	27,318
Percent with change in personal identifiers[2]								
First name	0.0	0.0	0.0	0.0	0.3	0.2	0.6	0.3
Last name	0.0	0.0	0.0	0.0	2.0	2.9	1.0	0.5
Date of birth	0.0	0.0	0.0	0.0	0.2	0.1	0.6	0.2
SSN	0.0	0.0	0.0	0.0	0.5	0.2	3.1	0.3
Gender	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Race	0.0	0.0	0.0	0.0	1.0	0.8	2.6	0.8
Percent with change in contact information								
Telephone	42.7	41.2	44.4	45.2	20.4	19.3	23.8	21.6
Street name[3]	49.1	47.8	51.6	50.8	36.0	34.3	41.1	37.8
City	13.4	12.6	14.5	14.3	13.3	12.5	15.6	14.1
County	4.6	4.4	5.0	4.9	11.6	11.3	12.7	11.9
ZIP code	23.4	22.2	25.5	25.1	21.6	20.4	25.2	23.1

1 Prevalence of change in identifying information is evaluated over the last last 12 months of participation for participants with at least 6 months of participation.
2 Change from missing to nonmissing is not counted, and vice-versa.
3 Change is evaluated after parsing the street name from the address field with the Census standardization software.

Table 13—Availability and prevalence of historical changes in personal identifying information for WIC participants[1]

	Florida				Iowa				Kentucky			
	Total	Women	Infants	Children	Total	Women	Infants	Children	Total	Women	Infants	Children
Number participants with multiple certifications	523,049	184,636	77,135	261,278	95,968	31,200	11,430	53,338	176,375	60,871	20,971	94,533
Percent with change in personal identifiers[2]												
First name	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.9	3.3	0.5
Last name	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	3.1	6.1	4.1	1.0
Date of birth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.8	0.2
SSN	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gender	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.9	0.2
Race	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.2	0.9	0.2
Percent with change in contact information												
Telephone	1.7	1.4	2.5	1.7	0.0	0.0	0.0	0.0	28.8	30.6	36.0	26.1
Street name[3]	1.6	1.4	2.4	1.5	0.0	0.0	0.0	0.0	26.3	28.8	36.9	22.4
City	7.5	5.7	9.7	8.2	0.0	0.0	0.0	0.0	10.2	11.3	14.0	8.6
County	0.2	0.2	0.3	0.2	0.0	0.0	0.0	0.0	4.0	4.8	5.6	3.1
ZIP code	1.0	0.8	1.5	1.0	0.0	0.0	0.0	0.0	13.2	14.6	18.7	11.1

1 Prevalence of change in identifying information is evaluated over the last two certification records for participants with multiple certifications.
2 Change from missing to nonmissing is not counted, and vice-versa.
3 Change is evaluated after parsing the street name from the address field with the Census standardization software.

Evidence from these programs suggests that personal identifiers are unlikely to change over time. Rates of changes in first name, DOB, SSN, gender, and race are less than one percent (except for infants) and most likely reflect corrections to erroneous entries and not true changes. Changes in last name are rare (one percent or less) for children in both Iowa FSP and Kentucky WIC. Evidence from Kentucky WIC, however, suggests that approximately five percent of women and infants change last name within a one-year period, possibly reflecting changes in marital status after childbirth.

Observed rates of change in contact information are likely to be equal or close to true rates of change for Florida FSP, Iowa FSP, and Kentucky WIC. Evidence from these programs indicate that 20 to 43 percent of program participants change telephone number within a year, 26 to 49 percent change street address, and 10 to 13 percent move to a new city.[42] Unfortunately, none of the three States provide direct within-State comparison of the mobility of FSP participants versus WIC participants.

Because none of the three States provided historical changes in identifiers for both FSP and WIC, record linkage results could be biased. Loss of data due to overwriting policies increases the potential for false negatives − that is, a failure to find a match when a match exists. The low rates of change for most personal identifiers suggest that this is not a large problem. However, changes in last name for WIC participants can pose a problem in establishing a match to FSP because marriage is a primary trigger for exit from FSP (Blank, 1993). Women who participate in both FSP and WIC but exit FSP after marriage may be observed with their maiden name in FSP and married name in WIC.

The high rates of change in contact information must be taken into account when specifying criteria for establishing a match between FSP and WIC records. For example, criteria can be specified such that corresponding address information helps to establish a match, while non-corresponding address information does not preclude a match.

Participation Dynamics Within FSP and WIC

The data for this study were collected retrospectively, resulting in a three-year snapshot of FSP and WIC caseloads, except for Kentucky FSP. For individuals observed in these files, participation histories may be truncated because participation may have started prior to the sample period (left-truncation) or continued after the sample period (right-truncation). Only one cohort of children is observed for a 36-month period from birth − infants born in January 2000.

Tables 14 and 15 show the distributions of FSP and WIC participants by total months of participation during the 3-year period. The total months need not be continuous, which means that the distributions contain participants with either single spells or multiple spells within the period. Infants and children are categorized according to age when first observed in the data file. The tables show unconditional and conditional percents. Unconditional percents are calculated over all participants observed during the three-year period. Conditional percents are calculated using a conditioned sample consisting of participants first observed more than 6 months (or 12 or 24 months) prior to the end of the sample period. For example, the conditional percent of participants with at least 12 months of participation is calculated over all participants who entered the program more than 12 months before the end of the sample period. Conditional percents provide better estimates of the distribution of months of participation in the face of right-truncation.

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[42] Among Florida FSP participants with a change in telephone number, 2 percent changed area code without changing the remaining 7-digits of the telephone number. Iowa FSP data did not include area codes.

Table 14—FSP participant dynamics: Number of months of participation during 2000-2002

	Unconditional percent		Conditional percent			
	Florida	Iowa	Florida		Iowa	
	Percent		Conditioned Sample Size	Percent[1]	Conditioned Sample Size	Percent[1]
Total W-I-C						
Number participants	1,194,425	180,171	–	–	–	–
Cumulative duration of						
> 6 months	60.0	59.3	1,082,163	66.2	160,894	66.4
> 12 months	38.5	38.9	950,731	48.4	142,600	49.2
> 24 months	16.4	15.7	711,949	27.5	102,335	27.7
Ever received cash assistance	33.8	55.9	–	–	–	–
Women of childbearing age						
Number participants	710,771	109,037	–	–	–	–
Cumulative duration of						
> 6 months	58.3	58.2	645,609	64.2	97,894	64.9
> 12 months	37.0	38.3	571,808	46.0	87,396	47.8
> 24 months	15.8	16.2	433,888	25.8	63,711	27.7
Ever received cash assistance	29.8	49.3	–	–	–	–
Infants						
Number participants	199,759	28,685	–	–	–	–
Cumulative duration of						
> 6 months	58.3	58.4	173,588	67.1	24,194	69.3
> 12 months	34.7	35.3	140,594	49.3	19,846	51.0
> 24 months	11.2	10.2	87,221	25.8	11,495	25.4
Ever received cash assistance	41.4	69.0	–	–	–	–
Children						
Number participants	283,895	42,449	–	–	–	–
Cumulative duration of						
> 6 months	65.3	62.5	262,966	70.5	38,806	68.4
> 12 months	45.0	42.8	238,329	53.6	35,358	51.4
> 24 months	21.6	18.3	190,840	32.1	27,129	28.6
Ever received cash assistance	38.5	64.1	–	–	–	–

[1] The denominators of the conditional percents are the conditioned sample sizes, which are the numbers of FSP participants first observed more than 6 months (or 12 or 24 months) prior to the end of the sample period. For example, the number of Florida FSP participants who had cumulative durations greater than 6 months was 716,297 (i.e., 59.97 percent of all 1,194,425 participants), which represents 66.2 percent of the 1,082,163 in the conditioned sample.

– Not applicable

Table 14 shows the percent of FSP participants with greater than 6, 12, and 24 months of participation on both a conditional and unconditional basis.[43] The unconditional percentages indicate that about 60 percent of FSP participants in Florida and Iowa are observed with more than 6 months of participation within a three-year period, 39 percent have more than 12 months participation, and 16 percent have more than 24 months participation. Conditional percentages indicate that 66 percent, about 50 percent, and 28 percent have more than 6, 12, and 24 months of participation, respectively.

[43] The percent of FSP participants with duration in a particular range can be obtained from the difference in cumulative percents. For example, the percent of Florida FSP participants with 12 to 24 months of participation is equal to the percent with ">12 months" less the percent with ">24 months", which is 38.5 – 16.4 = 22.1 percent.

Table 15—WIC participant dynamics: Number of months of participation during 2000-2002

| | State | | | | | |
| | Florida | | Iowa | | Kentucky | |
	Unconditional percent	Conditional percent	Unconditional percent	Conditional percent	Unconditional percent	Conditional percent
Total WIC						
Sample size[1]	981,464	856,511	163,649	145,252	329,778	295,585
Cumulative duration of						
> 6 months	76.0	87.1	83.6	94.2	83.6	93.3
> 12 months	39.8	53.5	47.3	61.2	46.7	59.6
> 24 months	10.5	22.5	13.5	26.1	10.1	20.2
Percent with multiple certifications	53.3	64.2	58.6	69.6	53.5	63.0
Percent with continuous multiple certifications[2]	29.5	35.1	43.0	50.7	41.0	48.0
Women						
Sample size[1]	336,940	289,509	52,441	45,831	102,262	90,290
Cumulative duration of						
> 6 months	64.5	75.1	82.8	94.8	82.9	93.9
> 12 months	20.7	29.3	33.5	45.3	36.1	48.3
> 24 months	0.7	1.8	2.0	4.5	2.0	4.4
Percent with multiple certifications	54.8	62.6	59.5	67.9	59.5	68.1
Percent with continuous multiple certifications[2]	38.5	43.6	47.8	54.2	49.0	55.7
Infants						
Sample size[1]	352,390	290,956	52,391	43,412	108,463	90,835
Cumulative duration of						
> 6 months	80.4	97.4	82.5	99.6	82.4	98.4
> 12 months	46.6	70.6	52.9	79.7	48.1	71.0
> 24 months	11.8	36.4	14.5	44.2	7.6	22.2
Percent with multiple certifications	43.0	62.2	47.4	69.3	35.5	50.2
Percent with continuous multiple certifications[2]	22.9	32.6	33.4	48.2	28.0	39.2
Children						
Sample size[1]	292,134	276,046	58,817	56,009	119,053	114,460
Cumulative duration of						
> 6 months	83.9	88.8	85.3	89.6	85.4	88.8
> 12 months	53.6	60.4	54.6	60.7	54.6	59.8
> 24 months	20.2	27.9	22.8	30.4	19.5	28.0
Percent with multiple certifications	64.0	67.6	67.9	71.1	64.6	67.3
Percent with continuous multiple certifications[2]	27.0	28.4	47.3	49.4	46.0	47.8

[1] The sample size for unconditional percents is the total number of persons participating in WIC at any time during the three-year period (e.g., 981,464 in Florida). The sample size for conditional percents is different for each measure, but can be derived from the table. The sample size shown for conditional percents is the conditioned sample size is for duration > 6 months. Conditioned sample size is equal to (unconditional percent) / (conditional percent) x (unconditional sample size). For example, 0.76/0.871 x 981464 = 856,386, which differs from 856,511 shown in table due to rounding of percents.

[2] Continous participation is defined by a "next" certification date within 30 days of the previous termination date, for all certification periods.

Within a three-year period, children have more months of FSP participation than women and infants. For example, using the conditional figures, 32 percent of children in Florida FSP participated longer than 24 months, compared with 26 percent of women and infants (the difference between children and others is smaller in Iowa). Intra-group differences between unconditional and conditional percents indicate that the impact of right-truncation is greatest for infants.

Duration of WIC participation is shown in table 15. Between 87 and 94 percent of WIC participants in the three States were enrolled in WIC for more than 6 months (on a conditional basis); 53 to 61 percent were enrolled at least 12 months; and 20 to 26 percent were enrolled more than 24 months. Table 15 shows that over 95 percent of WIC infants in all three States were enrolled more than 6 months, compared with 75-95 percent of women and 89-90 percent of children. Durations of more than 6 months are consistent with regulations allowing infants to be certified up until their first birthday, while women and children may be re-certified after an initial 6-month period. The conditional percent of WIC participants with multiple certifications (shown in table) is slightly higher for children (67-71 percent across States) compared with women (63-68 percent) and infants (50-69 percent).

WIC women have the shortest participation durations in the data, consistent with WIC eligibility that is limited to periods around childbirth. Table 15 shows that it is very unlikely for women to be enrolled in WIC more than 24 months within a 36-month period. WIC durations for women vary by State; the percent enrolled more than 12 months is 20 percentage points higher in Iowa and Kentucky, compared with Florida. WIC infants are initially enrolled in WIC up until their first birthday, and then, if still eligible, may be recertified as children.[44] The conditional percents show that 71 to 80 percent of infants were enrolled more than 12 months (i.e., re-enrolled as children) and fewer than half remain in WIC more than 24 months (the percents range from 22 to 44 percent across States). Compared with infants, those initially observed as children have somewhat lower conditional percentages of enrollment for at least 12 months (60-61 percent vs. 71-80 percent) and lower conditional percentages of enrollment for at least 24 months (28-30 percent vs. 22-44 percent).

Comparison of tables 14 and 15 shows that, within a three-year time period, women participate in FSP longer than in WIC − about 27 percent of FSP women and less than 5 percent of WIC women participate longer than 24 months. In contrast, infants participate in WIC longer than in FSP −about 26 percent of FSP infants and 22-44 percent of WIC infants participate longer than 24 months. Children are more likely to participate in WIC for more than 6 months, compared with FSP. But duration of at least 12 or 24 months is comparable for children in FSP and WIC.

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[44]   Most WIC infants are enrolled during the first three months after birth (91 percent in Iowa, 89 percent in Kentucky, and 83 percent in Florida).

Chapter Three

Methods

This chapter provides a brief description of data matching in general and a detailed description of the specific record linkage procedures used for this study.

Data Matching

The term "data matching" may be used to describe three different methods for linking data from multiple sources:

- **Match-merging.** Match of two data files by relying on an exact match of a single common identifier. This method is generally used only when data originate from the same data system or when identifiers (such as SSN) are highly reliable in both data files being matched, or verified in at least one of the data files. Match-merge is the simplest version of deterministic matching.

- **Deterministic matching with multiple identifiers.** Match of two data files using multiple identifiers (e.g., name and date of birth) and a match-merge technique relying on an exact match of identifiers. Multiple identifiers are used when a highly reliable single common identifier is not available.

- **Probabilistic matching.** Probabilistic record linkage is made when the calculated statistical probability of a match exceeds a certain threshold. Matches between two data files are based on comparison of multiple data fields in the two files. Identifiers need not match exactly; identifiers that do not match exactly are assigned a "distance" measure to express the degree of difference between files. Each identifier is assigned a weight (which is data driven) and the total weighted comparison for all identifiers being compared yields a score classifying records as linked, not linked, or uncertainly linked.

FSP and WIC do not share a common information system and do not share a common person ID. FSP and WIC records cannot be reliably linked via a merge on SSN because the SSN may not be equally reliable in the two files: FSP validates SSNs but WIC does not (according to the Phase 1 survey).[45] Because SSNs are not validated by both programs, there is potential for false positive and false negative results from a match on SSN. For this reason, probabilistic matching was the primary approach used for this study, with deterministic matching conducted for sensitivity analyses.

The typical steps in the data matching process are (Clarke, 1995):

- Record selection – selection of a subset of records meeting the population definition for the data that are being matched (described in chapter 2).

- Data standardization – data fields are standardized to impose consistent coding schemes or to parse free-form name and address fields into component parts that are more easily compared.

- Matching – the record-linkage process.

- Inferring – drawing conclusions about the accuracy of the match.

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[45]   In addition, it was found that WIC certification records are often missing SSNs for infants and young children.

There is a large literature on probabilistic record linkage that is summarized here only briefly.[46] From a theoretical standpoint, probabilistic matching involves the following sequence of events:

- Pairing every record in the base file (file A) with every record in the match file (file B).
- Comparing and scoring the quality of the match for each individual matching variable (e.g., name, SSN, date of birth).
- Applying weights to each matching variable to obtain an overall score.
- For each record in the base file (file A), identifying the matched pair with the highest overall score.
- Determining cutoffs for the overall score to classify matched records into: a) certain matches, b) uncertain matches, and c) certain non-matches.

From a practical standpoint, every record in file A cannot be paired to every record in file B because the Cartesian product is unmanageable.[47] For example, the Cartesian product of Iowa FSP and WIC records for December 2002 would yield a file of over 4 billion records. Typically data are blocked and paired within block (for example, within county); matches and non-matches are identified; and non-matches are re-blocked on different criteria.

Record Linkage Procedures

This study used "Record Linkage Software" from the Census Bureau (U.S. Bureau of Census, undated). The software includes name and address standardization programs as well as the record linkage program. The software is designed to perform one-to-one matching whereby one record in file A is matched to one record in file B. The programs are written in C and Fortran, and the compiled program executables run on personal computers.

The Census record linkage program contains the matching algorithms that are applied to data, using parameters specified by the user. The program leaves considerable decision-making up to the user because matching routines must be data driven, depending on the characteristics and quality of the data being matched. As a result, new users of the program can expect to devote considerable time adapting it to the application at hand.

The main steps in the process are:
1. Data reduction and unduplication
2. Data standardization
3. Determination of blocking variables
4. Determination of matching variables
5. Specification of match parameters
6. Review of match results and specification of score cutoff for certain matches

Each of these steps is discussed below. After processing data in steps 1 and 2, matching was done for: (a) active caseloads in December 2002, and (b) all participants active during the three-year period (Florida and Iowa only). The active caseloads in December 2002 contain one record per person and

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[46]   The seminal works are Newcombe (1959) and Fellegi and Sunter (1969). See also Winkler (1994 and 1999).

[47]   The Cartesian product of two databases is obtained by joining all the records from the first database with all the records from the second database in every possible combination.

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tell us the rate of multiple program participation at a point in time (contemporaneous participation). Utilizing all records for the three-year period involves multiple records per person and tells us, for example, the percent of WIC children ever participating in FSP within the three-year period (exposure).

Data reduction and unduplication

Data reduction is the process of reducing the size of data files by eliminating redundant data. The purpose is to enable efficient processing of the large files received from the States. This step was crucial for FSP data files, which were received with one record per participant per month. As discussed in chapter 2, many data fields showed no changes in individuals' information over time. Data were reduced by eliminating records where all data fields were identical except for month of participation; the one "unique" record that was retained was assigned indicators for months of participation from "dropped" records. Data reduction was done both before and after data standardization. The resulting file had multiple records for an individual only if personal identifiers or contact information changed.

Unduplication is the process of ensuring that each individual is associated with only one unique participant ID in each data file. FSP and WIC data from the three States were examined to assess the need for unduplicating prior to matching (for example, we sorted by SSN and participant ID to determine if a single SSN was associated with multiple IDs, and therefore lacked a unique ID). The incidence of duplicates was well below 1 percent and did not warrant the effort to systematically unduplicate the data.[48]

Data standardization

Data were standardized prior to running the record linkage program. Standardization ensures that truly identical data are evaluated as a match across data files. Three types of standardization were applied to the data:

> *Format standardization*. Data elements were assigned consistent names and formats in all files, imposing consistent coding schemes on categorical variables (race, gender, county) and consistent lengths on character variables.
>
> *Name standardization.* First and last name were parsed into separate data fields when a single name field was provided.[49] In all files, first names were standardized, to eliminate nicknames.
>
> *Address standardization*. A standardization program from the US Census Bureau was used to parse and standardize street address information. The standardization program parses a single street address field into separate fields for: house number, street prefix (e.g., east, west), street

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[48] A different "duplicate record problem" was found in the Kentucky WIC data. Kentucky WIC had unique IDs for participants, but there were duplicate records for the combination of participant ID and certification date. These appeared to be due to changes in address associated with transfers to a different local agency. Approximately 34,000 pairs of participant ID and certification date were observed and duplicates were deleted.

[49] The Kentucky FSP file included a single "name" field containing data in the form "last, first".

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name, street type (e.g., street, road, avenue), street suffix (e.g., east, west), rural route, and PO box.

Name standardization was implemented using a list of nicknames and corresponding full names that was supplied with the Census standardization programs but not invoked by the PC version of the programs. These nicknames were standardized to full names in SAS. [50] The Census nickname list contained 493 nickname-name pairs, but did not contain a large number of ethnic names, and was found to be more relevant to women than infants and children. For example, in the WIC programs, 7 to 11 percent of women's names were identified as nicknames across States, but only 4 to 6 percent of infants/children's names were identified as nicknames.

Address data pose the greatest challenge for standardization because of the variety of abbreviations and symbols that may be used within an address field. For example, street types may be spelled out (Street, Road, Avenue) or abbreviated (St, Rd, Ave); apartment numbers may be preceded by "#" or "No."; and directional prefixes or suffixes (North, South, East, West) may also appear as street names (e.g., 51 South Street). The Census address standardization subroutine parses address data into 10 component parts: [51]

Element Name [52]	Examples
1. House Number	123
2. Street Name Prefix	N, S, E, W
3. Street Name	Oak, Main, Martin Luther King
4. Street Name Suffix	Avenue, Blvd, Place, Court
5. Within Structure Designator	Bldg, Apt, #
6. Within Structure Indicator	5-W, 405
7. Rural Route Designator	RR
8. Rural Route Indicator	Usually a number
9. Box Designator	Box, PO, PO Box
10. Box Indicator	A letter or number

After running the Census standardization subroutine, a standard cleaning algorithm was applied to the parsed data. Street names were cleaned to remove all variations of the following: "unknown", "general delivery", homeless", "don't know", "none", "bad address", "moved", "returned", "undeliverable". Address fields were consolidated by the following rule: if street name (3) was missing, then street name (3) was set equal to "RR designator + RR indicator" (7 + 8) if nonmissing, else street name was set equal to "Box designator + Box indicator" (9 + 10) if nonmissing. This consolidation reduced the number of address fields used in the record linkage routines.

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[50] For example, each of the following names was standardized to Katherine: Kate, Kathey, Kathryn, Kathy, Katie, Katrin, Katrina, Katy, Kitty, Catalina, Catherine, Cathey, Cathie, Cathryn, Cathy.

[51] The Census Bureau claims that the address standardizer (written by the Geography Division of the U.S. Census Bureau) provides substantially higher standardization rates than commercial products when applied to the types of addresses that are common in the U.S. (Correspondence from William Winkler.)

[52] Taken from U.S. Bureau of Census (undated).

Parameters for matching

The Census software requires user specification of three items: blocking variables, matching variables, and matching parameters. These items depend on the content and characteristics of the data being matched.

Blocking variables. As specified by the Census software documentation, "blocking is a division of an entire file into mutually exclusive subsets." If data are blocked on first initial of last name, then there will be 26 blocks of data. Every person with last name starting with "A" in file X is paired with every person having last name starting with "A" in file Y, and similarly for all other letters in the alphabet. But a person with last name starting with "A" may get married, take a new last name, and appear in two databases with different last names. This person will not be matched when data are blocked on last name because the records will not even be compared. Data are typically blocked, matched, and re-blocked with different blocking variables to account for errors in blocking variables or changes in those variables over time.

FSP and WIC records were processed separately for women and infants/children. The data were also processed separately for: a) December 2002 active caseloads (Florida, Iowa, and Kentucky), and b) the entire three-year period (Florida and Iowa).

Women and infants/children were each processed through four blocking rounds, defined by the following blocking variables:

- Block 1: Date of birth, 1st initial of last name
- Block 2: 1st five characters of last name, 1st initial of first name
- Block 3: 1st three characters of first name, county[53]
- Block 4a: Social security number (Florida and Kentucky)
- Block 4b: Telephone number, county (Iowa and Kentucky)

Iowa files were not blocked on SSN because SSNs were not available for WIC infants and children. For Iowa, block 4 was defined by phone number and county, with county included because telephone numbers did not include area codes. Kentucky data were processed twice: once with the same specifications as Florida (including SSN) and once with the same specifications as Iowa (SSN not used).

Blocking variables pair up records from two files according to an exact match of the blocking variables. For example, every FSP record with a date of birth equal to January 1, 2000 and a last name beginning with A, gets paired to every WIC record with those characteristics. For Florida infants/children, this block contains 15 WIC records and 10 FSP records resulting in 150 pairs. Every pair is evaluated by comparing all match variables, discussed below.

Over 95 percent of all matches were found in the first round, indicating that 95 percent of all matches matched exactly on date of birth and first initial of last name. Records not matched in the first round were processed through subsequent rounds of blocking.[54]

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[53]   The first four characters of first name were used for Florida, due to the large size of the files.

[54]   The December 2002 caseloads were processed through 4 blocking rounds. The three-year caseloads were processed through 7 passes of 4 blocking rounds. The three-year caseloads contained multiple records per person reflecting

Matching variables and parameters. The Census software requires specification of match variables. For each match variable, the type of comparison and probabilities of agreement must be specified. Fourteen variables were evaluated in the match of FSP and WIC files. The variables are shown in table 16. Exact comparisons were used to match gender, race, some components of street address, ZIP code, and telephone number. String comparisons, which are phonetic and do not require exact matches, were used for all other variables.

Specification of match probabilities determines the contribution of individual variables to an overall match score for the paired records. Two probabilities must be specified: P_1, the probability that the variables match when the records truly belong to the same individual, and P_2, the probability that the variables match when the records do not belong to the same individual. A simple example of these probabilities (expressed as fractions) is $P_1=1$ and $P_2=0.5$ for gender, assuming no data entry errors for this data field.

Table 16

Matching variables and parameters

Match variable	Comparison type	Probability of agreement, if records match[a] (P_1)	Probability of agreement if records do not match[b] (P_2)
Last name	Special string comparison for last name; inversion option[c]	0.94	0.01
First name	Special string comparison for first name	0.93	0.01
Gender	Exact comparison[d]	0.99	0.50
Race	Exact comparison	0.95	0.32
Date of birth	Ordinary string comparison	0.99	0.01
SSN (Florida, Kentucky)	Ordinary string comparison	0.93	0.01
House number	Special string comparison for numeric address component	0.70	0.28
Street name	Ordinary string comparison	0.59	0.25
Apartment number	Exact comparison	0.45	0.20
Street suffix	Exact comparison	0.84	0.60
City	Ordinary string comparison	0.75	0.37
ZIP code	Exact comparison	0.72	0.28
Telephone number	Exact comparison	0.52	0.01
County	Exact comparison	0.93	0.06

[a] P_1 is expressed as a fraction and was based on the prevalence of matching data fields among Florida FSP and WIC matches identified by the Florida FSP/TANF/Medicaid ID that is present on both files.

[b] P_2 is expressed as a fraction and was based on the prevalence of matching data fields among the Cartesian product of that portion of a sample of Florida FSP and WIC records that excluded the matched sample used to calculate P_1.

[c] When last names do not match, the inversion option compares the last name on file A to the first name on file B, and vice versa, to see if the fields have been inverted.

[d] The exact comparison method requires that the variables being matched agree character-by-character in order to receive the full agreement weight.

changes in individual information. To make this match tractable, an FSP file with multiple records per person was matched, in turn, to 7 WIC files each having one record per person. WIC participants could have up to 7 WIC certification records and thereby appear in up to 7 files. After 7 passes, the highest match score for each WIC participant ID was identified as the best match.

The probabilities shown in table 16 were based on initial estimates obtained from Florida data. Certain matches can be identified in the Florida data for most persons with records in both files. The WIC database contains the State identifier that is used by the FSP/TANF/Medicaid system. This identifier was not used in our matching routines because a purpose of the project was to test probabilistic record linkage for these programs. But the identifier allowed us to check the results of record linkage and to generate estimates of match probabilities for individual variables.

P_1 and P_2 were estimated based on a single month of Florida data. All WIC records with nonmissing FSP/TANF/Medicaid ID were merged to the FSP file, and P_1 was calculated for that subset of matched records. The subset of matched records was then deleted from both FSP and WIC files, and the Cartesian product of unmatched FSP and WIC was used to estimate P_2.

As shown in table 16, the P_1 and P_2 match probabilities vary by data field. The P_1 probabilities reflect the reliability of the data field, the stability of information over time, and the potential for data entry errors. Gender and DOB have P_1 equal to 0.99; first and last name, race, and SSN also have P_1 over 0.90 percent. On the other hand, address fields have P_1 ranging from .45 to .84 and telephone number has P_1 equal to .52. This means that there is only slightly better than a 50 percent probability that a person's telephone number matches on the FSP and WIC data files.

P_2 is the probability that data fields agree when records do not belong to the same person. P_2 is low for items that are unique and/or take on many values within a population − such as SSN, name, and DOB. P_2 is high for items that have few values (race, gender, street suffix), or are not unique to specific persons in a population (ZIP code, city, street name).

The P_1 and P_2 values are used by the record linkage software to assign scores to individual data fields.[55] An overall score for a pair of records is equal to the sum of scores on individual fields. If probabilities P_1 and P_2 are far apart, the matching variable has a large distinguishing power. For example, a match of last name will contribute a large positive score to the overall score, while a non-match of last name will contribute a large negative score to the overall score. A match of gender contributes a *small* positive score, while a non-match of gender contributes a *large* negative score; a match of street name contributes a small positive score, while a non-match contributes a small negative score. Missing data for a data field on one or both files results in no contribution (positive or negative) to the overall score.

The blocking variables and matching variables completely specify the parameters for the Census software. In our implementation, we defined WIC as our base file, or File A. In each round of blocking and matching each record from the WIC file (File A) may be paired with more than one record from FSP (File B). All pairs were evaluated and scored. The WIC file (File A) was sorted by participant ID and overall match score and the pair with the highest score was kept. After each blocking round, data were manually reviewed to determine a cutoff for matches to be designated "certain", and all other records advanced to the next blocking round. After all rounds were completed, results from all rounds were combined, the WIC file (File A) was again sorted by participant ID and overall match score, and the pair with the highest score was kept.

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[55] The score when a data field matches is based on an initial value equal to the base 2 logarithm of the ratio of P_1 and P_2. The score when a data field does not match is based on an initial value equal to the base 2 logarithm of the ratio of $(1-P_1)$ and $(1-P_2)$.

While 95 percent of all *matches* were matched in the first round, a large number of records – including ones never to be matched – advanced to subsequent rounds. After the final round, non-matches were categorized as "uncertain matches" or "certain non-matches." Uncertain matches were manually reviewed to develop SAS code for re-categorizing pairs as matches or non-matches.

SAS code was used in place of manual review of every "uncertain" pair. This processing identified pairs with low scores that met the following criteria:
  - First name, date of birth, and SSN match.
  - First name, last name, and SSN match.
  - First name, date of birth, and telephone number match.
These pairs were recategorized as matches. The low scores, in these cases, were due to the "penalty" imposed by a non-matching last name or address.

The distribution of match scores, for all pairs that were determined to match, is shown in Figures 5–7. The matches below the cutoff are pairs that were recategorized. The graphs for Florida and Kentucky show a similar range of scores (up to 32) and two "spikes" above the mean. In these two States, the highest density of matches is located in the rightmost "spike." Iowa matches show a narrower range of scores (up to 25) and two "spikes" of approximately equal density. The lower mean scores in Iowa reflect the absence of SSN as a matching variable.

Figure 5 - Florida matches, All 3 years
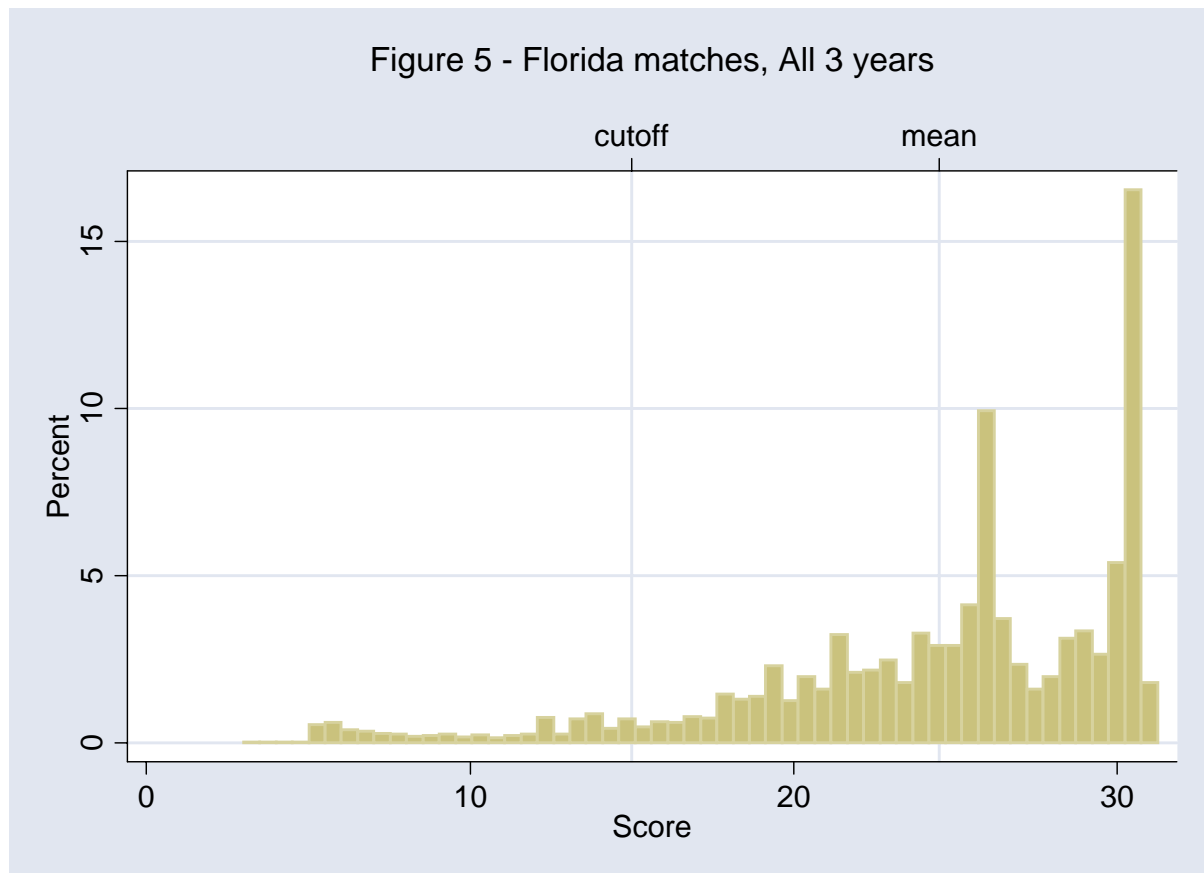
Figure 6 - Iowa matches, All 3 years
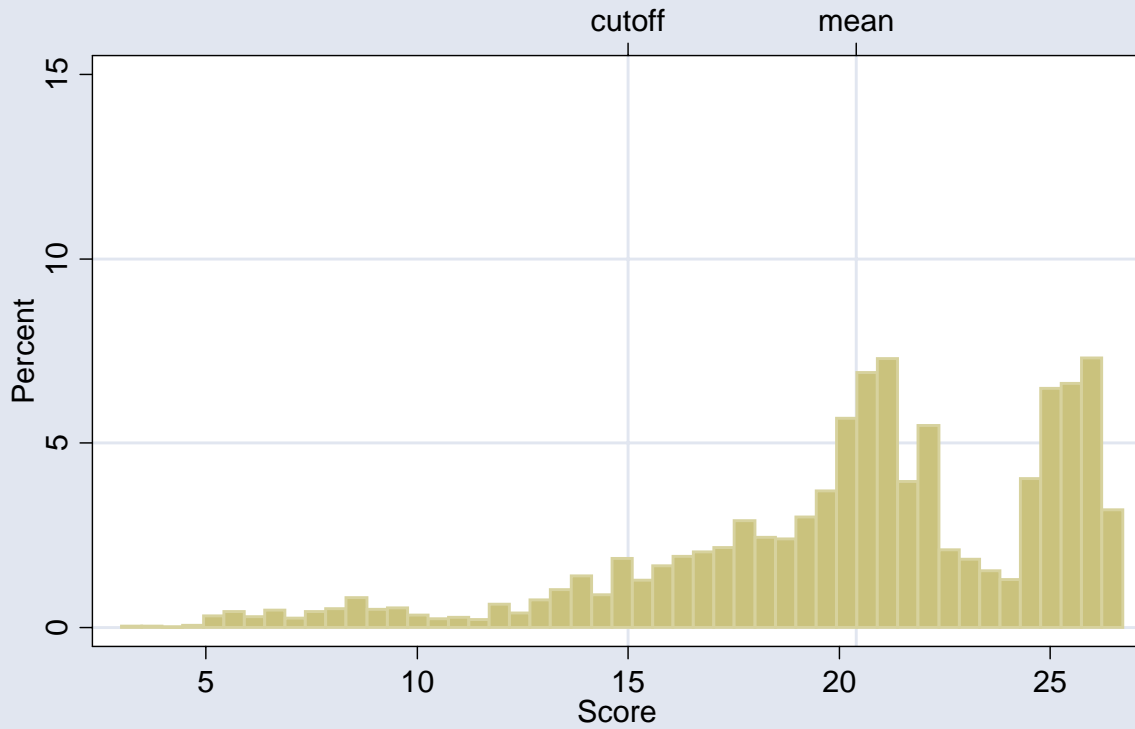
Figure 7 - Kentucky matches, December 2002
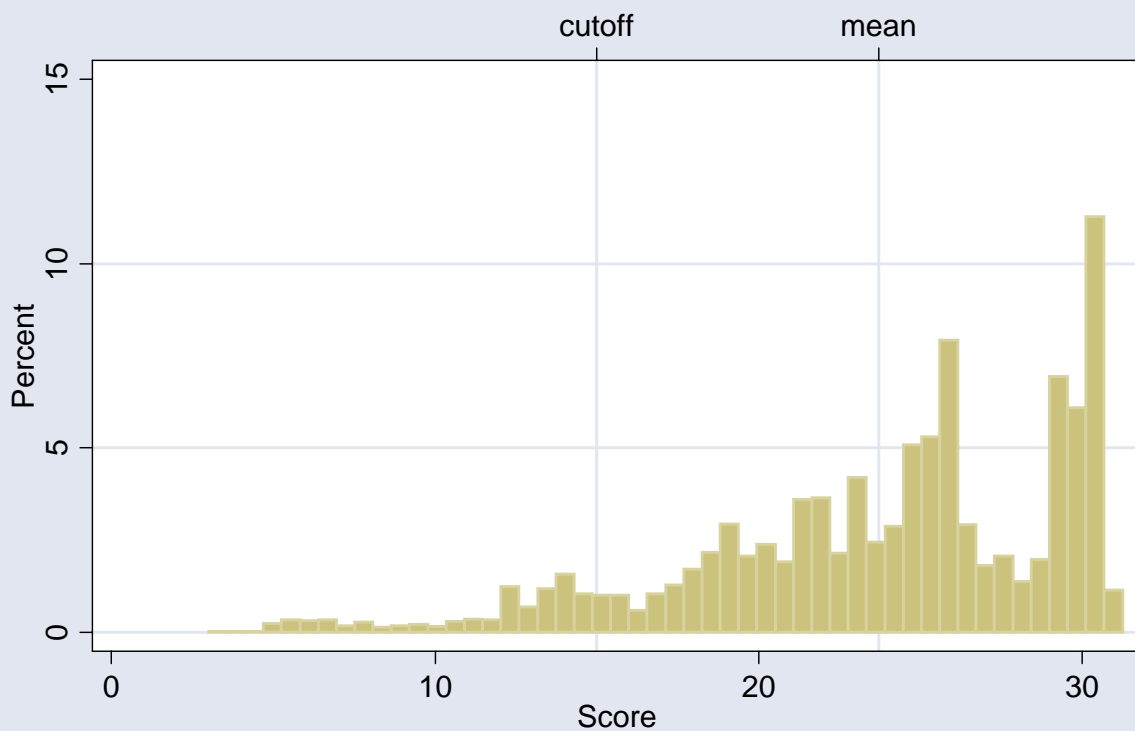
Chapter Four

Results

This chapter presents record linkage results for FSP and WIC participants. The match rates are estimates of multiple program participation. Results are described in terms of the percent of WIC participants also participating in FSP, and the percent of FSP participants also participating in WIC. Rates of multiple program participation are presented for the December 2002 active caseload (contemporaneous participation) and for the three-year caseload (exposure). In the latter case, the timing of participation across programs is described.

In addition to the descriptive account of multiple program participation, three other analyses describe participation dynamics: WIC participation by siblings in FSP households; multiple program participation rates for January birth cohorts; and multivariate analyses of the characteristics associated with multiple program participation. The final section of this chapter compares probabilistic match results to simpler methods of merging FSP and WIC data to assess the relative accuracy of those methods.

Record Linkage Results for WIC Participants

Table 17 presents rates of contemporaneous multiple program participation for WIC participants active in December 2002 (i.e., the percent of WIC participants also participating in FSP in December). To put the results into context, the first three columns of the table show the total number of WIC participants in December, the percent with income at or below 130 percent of poverty at certification, and the percent that reported participation in the FSP at certification.[56] Match results are shown in columns 4 to 6. Column 4 shows the overall match results for the entire December 2002 WIC caseload; columns 5 and 6 show match results within the subgroups that did and did not report FSP participation when enrolling in WIC.

The overall percent of WIC participants matched to the FSP files (column 4) was 28 percent in Florida, 26 percent in Iowa, and 45 percent in Kentucky. The match rates vary slightly across participant category within States, with children having the highest match rate in all States.

Match rates, in the range of 26 to 45 percent across States, are significantly lower than the percent of WIC participants with income below 130 percent of poverty at certification (77 to 83 percent). This difference is due to at least three factors. First, WIC participants' income may change after WIC certification making them ineligible for FSP; second, WIC participants with income less than 130 percent of poverty may be ineligible for FSP due to FSP resource limits or non-financial FSP eligibility criteria (citizenship, residency, and immigration status); and third, WIC participants eligible for FSP may choose not to participate.

Match rates in all States are higher than the percent of WIC participants reporting FSP participation to the WIC program. The difference is 8 percentage points in Florida, 4 percentage points in Iowa, and over 20 percentage points in Kentucky. (The difference in Florida is disproportionately due to

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[56] Income at or below 130% of poverty and adjunct eligibility status were measured at certification and may not reflect status in December 2002.

Table 17—Record linkage results for WIC participants, December 2002

	Active WIC caseload in December 2002			Percent of WIC caseload matched to FSP		
	Number participants	Percent income ≤130% poverty[1]	Percent reported FSP to WIC	Percent of total	Percent matched among those reporting FSP	Percent matched among those not reporting FSP
Florida						
Total WIC	403,477	82.84	20.06	28.32	73.41	14.04
Women						
Age 18 and under	11,467	88.57	21.39	24.59	67.43	10.06
Age 19-34	78,028	81.60	18.70	21.83	70.70	8.03
Age 35 and over	9,111	81.25	14.26	16.48	72.13	5.31
Total	98,606	82.38	18.60	21.65	70.36	8.00
Infants	112,352	82.77	3.78	23.55	59.07	21.89
Children						
Age 1	72,874	82.34	27.71	32.36	74.09	11.48
Age 2	50,772	83.14	30.94	35.18	76.17	11.43
Age 3	42,064	83.43	32.25	36.11	76.72	11.46
Age 4	26,809	84.70	33.17	36.65	75.09	10.49
Total	192,519	83.12	30.31	34.53	75.42	11.33
Iowa						
Total WIC	70,239	76.84	22.74	26.46	66.07	14.78
Women						
Age 18 and under	1,995	84.89	14.74	24.62	63.94	17.81
Age 19-34	13,965	76.23	18.75	25.88	69.49	15.79
Age 35 and over	1,025	74.00	14.34	20.79	69.38	12.53
Total	16,985	77.12	18.02	25.42	68.95	15.83
Infants	17,227	78.39	19.46	21.96	54.73	14.04
Children						
Age 1	13,404	75.50	25.04	27.21	65.57	14.40
Age 2	9,115	76.52	27.45	30.92	71.78	15.47
Age 3	8,084	75.64	27.57	29.53	69.45	14.31
Age 4	5,424	76.63	27.12	29.96	72.20	14.24
Total	36,027	75.96	26.53	29.08	69.12	14.62
Kentucky						
Total WIC	131,174	83.04	22.26	45.09	78.24	35.60
Women						
Age 18 and under	4,490	88.68	21.18	43.34	73.29	35.29
Age 19-34	26,750	81.55	21.71	42.06	78.55	31.94
Age 35 and over	1,498	77.96	21.03	38.32	83.49	26.29
Total	32,738	82.28	21.61	42.06	78.06	32.14
Infants	33,965	84.04	14.59	38.24	69.67	32.87
Children						
Age 1	24,104	82.50	22.52	47.59	79.24	38.39
Age 2	16,395	82.76	27.03	50.95	81.58	39.60
Age 3	13,823	83.93	29.52	52.35	81.99	39.93
Age 4	10,149	83.41	31.78	52.52	80.81	39.34
Total	64,471	83.04	26.62	50.24	80.79	39.15

[1] Percent is calculated over persons with nonmissing income, plus persons with missing income and reported participation in FSP or TANF; the latter are assumed to have income below this cutoff.

infants.) This difference may be due to two factors: a) the timing of the data and b) underreporting of FSP participation to the WIC program. Timing problems are due to the fact that WIC participants report FSP participation at certification, but December WIC participants were certified during the prior 6 months (or one year for infants) and FSP participation status can change over time with WIC participants going on or off FSP. On the other hand, FSP participation may be underreported to the WIC program. As noted earlier, WIC administrative data provide a lower bound estimate of FSP participation. WIC applicants who participate in multiple adjunct programs need to verify participation in only one program to establish WIC eligibility and there may be limits on the number of adjunct programs that local WIC staff can enter in WIC computer systems.[57]

Across States, between 66 and 78 percent of WIC participants reporting FSP participation at certification were still participating in December (column 5). Among WIC participants with no reported FSP at certification, 14 percent in Florida, 15 percent in Iowa, and 36 percent in Kentucky were receiving FSP in December (column 6).

The Kentucky match results indicate a relatively large percentage of WIC participants either enroll in FSP after WIC certification or underreport FSP participation to the WIC program. The timing of enrollment in FSP relative to WIC could not be examined because Kentucky FSP data were available only for December 2002. The hypothesis that FSP participation is underreported to WIC was investigated by examining the match rate for WIC participants *certified* in December 2002 (a subset of those active in December). Of those certified in December, 22 percent reported FSP participation to the WIC program and 44 percent were matched to the FSP data for December 2002 (not shown in table). Kentucky WIC participants underreport FSP participation to the WIC program, although we do not have data to explain why they underreport.

Table 18 presents match results for the *three-year period* for Florida and Iowa (Kentucky FSP did not provide data for the three-year period). The results in this table describe exposure of WIC participants to FSP during the three-year period and the timing of FSP participation relative to WIC certification. To examine the timing of participation, the unit of observation in this table is WIC certifications, not WIC participants. A person may have multiple WIC certifications.

The first three columns of table 18 are similar to table 17, showing the total number of WIC certifications, the percent with income below 130 percent of poverty, and the percent with FSP reported to the WIC program. Column 4 shows that over 50 percent of WIC participants in Florida and Iowa participated in FSP sometime during the three-year period. This compares to 26-28 percent that participated in FSP in a single month (table 17). These results indicate that WIC participants may have income that fluctuates around the FSP income threshold, or that WIC applicants enroll in FSP as a result of WIC referrals. To provide greater detail on the dynamics of multiple program participation, the last three columns of table 18 describe the timing of FSP participation relative to WIC certification dates.

Except for infants in Iowa, there is a remarkable correspondence between the percent of WIC certifications with reported FSP participation, and the percent matched to the FSP file and active in FSP during the WIC certification month. Overall, 24 percent of Florida WIC certifications reported FSP participation and 25 percent were found to be active in FSP during the WIC certification month.

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[57] Among the three States, Kentucky WIC participants were least likely to report more than one adjunct program (18.6% compared with 23% in Iowa and 24.7% in Florida).

Table 18—Record linkage results for WIC certifications during 3-year period, January 2000 - December 2002

	Number WIC certifications	Characteristics		Percent of WIC certifications matched to FSP			
		Percent income ≤130% poverty[1]	Percent reported FSP to WIC	Percent EVER received FSP	Percent matched and active in FSP:[2]		
					In WIC certif. month	During WIC certif. period	Before or after WIC certif. period
Florida							
Total WIC	1,933,091	81.77	24.22	52.32	24.86	12.98	14.48
Women							
Age 18 and under	93,285	85.59	23.58	52.51	23.59	11.56	17.37
Age 19-34	432,561	80.53	21.45	43.26	21.16	9.21	12.89
Age 35 and over	50,167	80.78	16.30	32.51	16.16	6.55	9.79
Total	576,013	81.37	21.35	43.82	21.12	9.36	13.35
Infants	358,872	81.85	13.44	44.56	10.95	27.85	5.76
Children							
Age 1	388,404	81.02	27.84	57.76	30.08	10.18	17.50
Age 2	254,128	82.04	30.60	61.73	32.62	10.04	19.07
Age 3	207,856	82.51	30.92	61.23	33.35	9.71	18.18
Age 4	147,818	83.52	31.72	61.31	34.26	8.02	19.03
Total	998,206	81.96	29.76	60.02	32.03	9.73	18.27
Iowa							
Total WIC	352,903	74.17	22.30	54.65	22.34	17.46	14.85
Women							
Age 18 and under	11,816	85.66	14.48	58.88	18.21	20.08	20.58
Age 19-34	76,682	76.51	18.40	51.37	21.33	15.97	14.06
Age 35 and over	5,411	73.66	14.06	41.21	18.59	11.53	11.09
Total	93,909	77.50	17.65	51.73	20.78	16.23	14.71
Infants	53,015	74.08	18.94	46.36	4.53	36.23	5.60
Children							
Age 1	74,475	72.28	23.93	56.37	26.21	13.90	16.26
Age 2	50,912	72.42	26.03	59.32	28.26	13.75	17.31
Age 3	44,592	72.73	26.20	59.39	28.48	13.26	17.65
Age 4	36,000	73.79	25.83	58.41	28.63	10.83	18.95
Total	205,979	72.67	25.27	58.11	27.63	13.19	17.29

Note: Kentucky is not included in the table because data for the three-year period was not available from Kentucky FSP.

[1] Percent is calculated over persons with nonmissing income, plus persons with missing income and reported participation in FSP or TANF; the latter are assumed to have income below this cutoff.
[2] Categories are mutually exclusive.

For Iowa, the percents nearly match exactly (22 percent). There appears to be slight underreporting of FSP participation to the WIC program for women (Florida only) and children (both States), and overreporting for infants (more severe in Iowa). The lower match rates for infants may occur because infant certification in WIC may incorporate information about the mother's FSP participation, while actual enrollment of an infant in FSP may occur with a lag. But we have no information for why this may occur more frequently in Iowa than Florida.

In Florida and Iowa, respectively, 13 and 17 percent of WIC certifications were of persons who enrolled in FSP after enrolling in WIC but during the WIC certification period, indicating the possible role of WIC referral services. An additional 14 percent of WIC certifications in each State were of persons who participated in FSP either before or after, but not during, the WIC certification period.

Altogether, for columns 7 and 8, more than one-fourth of all WIC certifications were of persons who matched to the FSP file but were not active in FSP during the WIC certification month.

Table 19 shows the match results for WIC certifications, broken out separately by FSP participation reported to WIC at the time of WIC certification. This table shows that, despite the remarkable correspondence in table 18 between reported FSP participation and match rates overall, there is some disagreement within subgroups of WIC participants that did and did not report FSP to the WIC program. Only 71-72 percent of WIC participants reporting FSP participation were found active in FSP during the WIC certification month, and nearly 10 percent of those with no reported FSP participation were found active in FSP during the WIC certification month.[58]

Record Linkage Results for FSP Participants

Record linkage results for December 2002 FSP participants are shown in table 20. These results show that, in all three States, approximately 30 percent of FSP women of childbearing age, infants, and children under age 5 (W-I-C) were matched to the WIC caseload in December 2002. All women of childbearing age are included in this analysis because pregnant women cannot be identified in the FSP data.

Match rates for FSP participants vary by participant category in a consistent way across States. The match rates for FSP women with no infant in the household are 6 to 7 percent; for postpartum women within 6 months of childbirth, the match rates are 79 to 88 percent; for postpartum women 7 to 12 months after childbirth, the match rates are 24 to 35 percent; 84 to 94 percent of FSP infants receive WIC; and 51 to 57 percent of FSP children receive WIC. The percent of FSP children participating in WIC at a point in time declines with age, consistent with evidence of an overall decline in WIC participation with age from WIC administrative data (Bartlett, et al., 2002).

The relative timing of participation in FSP and WIC is shown in table 21. This table examines the subset of FSP participants who were active in FSP anytime during the seven months from March to September 2001 (middle of the sample period), with age measured as of June 2001. Each person in this sample is characterized by their history of participation in FSP and WIC over the full three-year period, January 2000 to December 2002. The sample restriction alleviates the effects of left-truncation and right-truncation because each FSP participant in the sample (March – September) has a 15-month participation history prior to March and a 15-month participation history following September. The impact of left-truncation is eliminated for FSP women with infants because they are observed prior to the infant's birth date. Left-truncation is also eliminated for infants and children age 1-year-old because their participation histories are observed since birth. Left-truncation is not eliminated for older children.[59]

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[58] Analysis of participation dynamics across program is inherently imprecise. WIC data identify dates of enrollment, while FSP data identify months of benefit receipt but not the month in which individuals enroll for benefits. This difference should matter most for FSP participants enrolling toward the end of one month and receiving initial benefits the next month. Results presented in table 19 were not changed substantially by relaxing the definition of column 6 to be the "percent of WIC participants matched and active in FSP in WIC certification month or month after."

[59] FSP children who were 2-years-old in June 2001 were 7 months old in January 2000. The percent of 2-year-olds who ever participated in WIC may be underestimated because data are not available for from birth to age 7 months.

Table 19—Record linkage results for WIC certifications during 3-year period, by report of FSP to WIC program

	WIC certifications with reported FSP participation				WIC certifications with no reported FSP participation			
	Number WIC certifications	Percent matched and active in FSP:[1]			Number WIC certifications	Percent matched and active in FSP:[1]		
		In WIC certif. month	During WIC certif. period	Before or after WIC certif. period		In WIC certif. month	During WIC certif. period	Before or after WIC certif. period
Florida								
Total WIC	468,229	71.96	17.92	8.86	1,464,862	9.81	11.40	16.27
Women								
Age 18 and under	21,998	72.73	17.89	7.46	71,287	8.42	9.60	20.43
Age 19-34	92,784	75.54	15.59	6.86	339,777	6.31	7.47	14.54
Age 35 and over	8,175	76.39	14.58	5.72	41,992	4.44	4.99	10.59
Total	122,957	75.10	15.94	6.89	453,056	6.47	7.57	15.10
Infants	48,230	28.43	57.03	11.39	310,642	8.24	23.32	4.88
Children								
Age 1	108,126	73.90	14.02	11.41	280,278	13.18	8.70	19.85
Age 2	77,758	75.64	13.20	10.67	176,370	13.65	8.65	22.77
Age 3	64,269	78.63	12.77	8.01	143,587	13.08	8.34	22.73
Age 4	46,889	88.79	6.82	3.68	100,929	8.92	8.58	26.17
Total	297,042	77.73	12.40	9.26	701,164	12.66	8.59	22.08
Iowa								
Total WIC	78,680	70.80	21.82	3.73	274,223	8.43	16.21	18.04
Women								
Age 18 and under	1,711	70.25	21.10	4.27	10,105	9.40	19.91	23.34
Age 19-34	14,107	76.48	16.72	2.89	62,575	8.90	15.81	16.58
Age 35 and over	761	75.16	17.08	2.76	4,650	9.33	10.62	12.45
Total	16,579	75.78	17.18	3.02	77,330	8.99	16.03	17.22
Infants	10,042	15.46	75.78	0.94	42,973	1.97	26.99	6.69
Children								
Age 1	17,823	78.85	13.61	4.44	56,652	9.65	14.00	19.98
Age 2	13,252	79.81	13.13	4.22	37,660	10.12	13.97	21.91
Age 3	11,684	80.15	12.80	4.55	32,908	10.13	13.43	22.30
Age 4	9,300	81.67	11.25	4.96	26,700	10.16	10.68	23.82
Total	52,059	79.89	12.88	4.50	153,920	9.96	13.29	21.61

[1] Categories are mutually exclusive.

Table 21 shows that a significant number of FSP women with infants never participated in WIC – 17 percent in Florida and 9 percent in Iowa. One-third of FSP women with infants participated in the FSP before, during, and after WIC enrollment (in both Florida and Iowa). Nearly all FSP women participating in WIC did so concurrently with FSP for at least some period of time. FSP participation preceded WIC enrollment for over 30 percent of women in both States; WIC enrollment preceded FSP enrollment for 14 percent of women in Florida and 19 percent in Iowa.

Only 4 percent of Iowa FSP infants and 11 percent of Florida FSP infants were never in WIC during the three-year period. The majority of FSP infants received FSP while in WIC but not before or after

Table 20—Record linkage results for FSP participants, December 2002

	Florida		Iowa		Kentucky	
	Number FSP participants	Percent matched to WIC	Number FSP participants	Percent matched to WIC	Number FSP participants	Percent matched to WIC
Total W-I-C	388,817	29.4	60,345	31.0	200,013	29.6
Women with no infant in household[1]	211,875	6.8	33,138	5.9	117,515	5.7
Women up to 6 months postpartum	5,876	78.7	1,849	85.5	5,691	88.0
Women 7-12 months postpartum	9,805	24.1	2,228	35.3	6,053	33.8
Total women	227,556	9.4	37,215	11.6	129,259	10.7
Infants	29,953	87.7	4,655	83.8	14,016	94.3
Children						
Age 1	34,030	60.3	4,782	64.2	14,384	68.7
Age 2	33,712	52.2	4,763	60.1	14,526	57.1
Age 3	32,066	48.2	4,660	53.1	14,149	51.8
Age 4	31,500	41.7	4,270	48.2	13,679	48.8
Total children	131,308	50.8	18,475	56.6	56,738	56.7

[1] Includes women of childbearing age who never gave birth, were pregnant but did not have live birth, or are currently pregnant.

Table 21—Timing of program participation for women, infants, and children active in FSP during March 2001—September 2001[1]

		FSP Participant Category[2]					
	Total	Women with infants[3]	Infants	Children Age 1	Children Age 2	Children Age 3	Children Age 4
Florida							
Number FSP participants	312,046	62,247	52,891	43,295	40,725	47,576	65,312
Timing of FSP relative to WIC[4]							
Percent							
Never received WIC (u)	29.2	17.0	10.8	15.8	26.2	38.3	59.9
FSP before WIC	0.8	0.9	0.8	1.0	1.4	0.8	0.1
FSP before and during WIC	13.8	14.0	5.9	24.1	29.3	15.6	2.1
FSP before, during, and after WIC	18.9	33.8	2.2	10.6	15.2	24.2	22.2
FSP during WIC (u)	20.8	9.0	60.3	30.7	18.8	10.4	2.1
FSP during and after WIC (u)	14.3	20.2	19.6	15.5	7.2	9.2	12.0
FSP after WIC (u)	1.6	4.0	0.3	1.8	1.4	0.9	1.0
Iowa							
Number FSP participants	49,719	12,631	7,842	6,417	6,335	7,066	9,428
Timing of FSP relative to WIC[4]							
Percent							
Never received WIC (u)	18.1	9.2	4.0	9.9	16.5	26.1	42.5
FSP before WIC	0.6	0.2	0.3	1.0	1.2	1.1	0.1
FSP before and during WIC	13.6	15.1	2.4	23.2	29.8	15.2	2.4
FSP before, during, and after WIC	20.8	32.4	1.1	10.1	14.2	27.1	28.6
FSP during WIC (u)	25.1	11.4	71.1	37.7	26.2	15.1	3.3
FSP during and after WIC (u)	19.2	26.6	20.8	16.2	10.2	13.6	20.3
FSP after WIC (u)	1.9	4.1	0.1	1.5	1.3	1.2	1.5

[1] The full data extract period (January 2000—December 2002) was used to determine the history of participation in FSP and WIC for the sample of FSP participants shown in this table.
[2] Age is measured as of June 2001.
[3] Women with infants in their FSP case and having 'relation-to-head' codes that are compatible with a mother-infant relationship (e.g., spouse-daughter, sister-niece, daughter-granddaughter); restricted to mother-infant pairs with infant date of birth after June 2000 and before July 2002.
[4] Categories are mutually exclusive.
(u) Estimates for children age 2-4 are underestimated due to left-truncation.

(60 percent in Florida and 71 percent in Iowa). An additional 19-20 percent of infants received FSP and WIC concurrently and continued to receive FSP after WIC participation ended.

The cohort of 1-year-old FSP participants is observed in the data since birth. Their participation histories are not impacted by left-truncation, yet they show very different multiple program participation dynamics, when compared to infants. The percent of FSP 1-year-olds never participating in WIC is 10 percent in Iowa and 16 percent in Florida (compared with 4 and 11 percent of infants). Only half as many 1-year-olds, compared to infants, received FSP while in WIC but not before or after (31 and 38 percent vs. 60 and 71 percent). About one-fourth of 1-year-olds have FSP participation preceding WIC participation (compared with only 3 and 6 percent of infants). The difference in participation dynamics for one-year-olds and infants reflects that fact that some one-year-olds were not eligible for FSP or WIC, or did not participate in programs for which they were eligible, during their infant year.

Cohorts of 2-, 3-, and 4-year-old FSP participants, shown in table 21, have incomplete participation histories due to left-truncation. The results for these age groups should be viewed with caution. Results show that the percent of FSP children never receiving WIC increases with age. This reflects both the incomplete participation histories and the decline in WIC participation with age (Bartlett, et al., 2002). For example, 4-year-old FSP participants are not observed prior to age 2½, but may have received WIC as infants. On the other hand, some 4-year-old FSP participants are in households experiencing a recent decline in income and never received WIC and, at age 4, are less likely to receive WIC than younger cohorts. Despite the limitations of data truncation, the data show that, among FSP children receiving WIC at some point in the three-year period, nearly all received FSP and WIC concurrently for some period of time. Across all age groups, in both States, fewer than 3 percent of FSP children received FSP only before WIC or only after WIC.

Timing of WIC participation by FSP mothers

Table 22 describes the timing of WIC participation for FSP women with infants born during the three-year period. Most FSP mothers (78 percent in Florida and 85 percent in Iowa) participated in WIC during the three-year period. Among Florida FSP mothers participating in WIC, 57 percent participated in WIC during both pregnancy and postpartum, 14 percent participated in WIC during pregnancy only, 26 percent participated postpartum only, and 3 percent did not participate in WIC during the last live birth. Iowa FSP mothers were more likely to participate in WIC during both pregnancy and postpartum, compared with Florida. Only 4 percent of Iowa mothers participated in WIC during pregnancy without postpartum participation, compared with 14 percent of Florida mothers.

WIC participation by FSP siblings

Throughout this report, multiple program participation is examined at the level of the individual program participant. Another way to look at program participation is from the family's perspective. FSP and WIC programs differ, however, in that FSP enrolls households while WIC enrolls individuals. FSP eligibility is driven primarily by financial considerations while WIC has categorical and nutritional risk criteria as well. As a result, families receiving benefits from both programs may not have all age-eligible children enrolled in WIC.

Table 22—Timing of WIC participation for FSP mothers[1]

	Florida	Iowa
Number women with infants	112,313	22,362
Percent ever participated in WIC	78.25	85.29
Of those ever in WIC, percent by timing of WIC participation during last live birth		
During pregnancy and postpartum	56.65	65.34
During pregnancy only	14.39	3.67
Postpartum only	25.60	28.34
No WIC participation with most recent child	3.36	2.65

[1] Sample is limited to non-complex households, defined as FSP households with no individuals who change case number (i.e., household) during the three-year period.

Table 23 shows the WIC participation of FSP siblings during the three-year sample period. The number of children under age five is the count of all children in a household who were under age five at any time in the three-year period.[60] The main pattern observed in these data is that WIC participation by *any* children in a family is more likely as the number of children increases.

Florida FSP households with one child under age 5 have a 57 percent WIC participation rate; households with two, three, and four children have 74 percent, 84 percent, and 89 percent WIC participation rates, respectively.[61] Iowa FSP households with one child under age 5 have a 66 percent WIC participation rate; households with two, three, and four children have, respectively, 82 percent, 90 percent, and 93 percent WIC participation rates. As the number of siblings in a family increases from one to four, the probability that *all* siblings under age 5 participate in WIC during a three-year period declines from 57 percent to 33 percent in Florida and from 66 percent to 55 percent in Iowa.[62] As the number of siblings increase, however, the range of ages also increases and, as shown earlier, WIC participation declines with age. Part of this decline is also due to right-truncation of the data and would not be observed in data covering a longer time period.

Multiple Program Participation by January Birth Cohorts

This study examined three-year snapshots of FSP and WIC caseloads. Within these caseloads, rates of multiple program participation for children decline with age. To present this "age effect" clearly, table 24 shows rates of program participation for cohorts of January births in each year, as a percent of all births. Included in this analysis are all children in the FSP and WIC files with January birth dates. Cohorts are shown in columns labeled infants to 4-year-olds, according to age in January 2000.

[60] A household with 2 siblings under age five may include one child who turns 5-years-old during the sample period and another who is born after the first turns 5.

[61] Derived by adding figures in a column, excluding the row for zero children matched to WIC data.

[62] WIC enrollment of siblings is not necessarily contemporaneous.

Table 23—WIC participation of FSP siblings[1]

	Number of children under age five in FSP household			
	One	Two	Three	Four
Florida				
FSP households with children under age five, by number of children under age five				
Number	175,182	80,816	23,191	6,261
Percent	61.4	28.3	8.1	2.2
Distribution of households by number of children matched to WIC data[2]				
Zero	43.4	26.2	16.2	10.8
One	56.6	23.4	12.8	8.9
Two	–	50.4	30.4	17.5
Three	–	–	40.6	30.1
Four	–	–	–	32.6
Iowa				
FSP households with children under age five, by number of children under age five				
Number	26,511	13,769	4,019	784
Percent	58.8	30.5	8.9	1.7
Distribution of households by number of children matched to WIC data[2]				
Zero	34.0	18.0	9.8	7.4
One	66.0	16.3	5.5	3.7
Two	–	65.7	24.1	8.2
Three	–	–	60.5	26.3
Four	–	–	–	54.5

[1] Sample is limited to non-complex households, defined as FSP households with no individuals who change case number (i.e., household) during the three-year period.
[2] WIC participation of FSP children is observed only during the three-year period from January 2000 - December 2002. As a result, percent of FSP children ever participating in WIC is underestimated.
– Not applicable.

The rate of participation in FSP or WIC, for January birth cohorts as a percent of all births, declines from 69 percent for infants to 39 percent for 4-year-olds in Florida; and from 58 percent for infants to 33 percent for 4-year-olds in Iowa. The percent *ever* participating is underestimated, however, because the three-year-snapshot provides a complete participation history only for the cohort of infants in January 2000.

The real decline in program participation with age is seen in the change in participation rates *within* cohort over time. For example, Florida infants had a rate of participation in *FSP or WIC* of 59 percent during 2000, declining to 47 percent during 2001, and falling further to 42 percent during 2002. In other words, participation declined 13 percentage points between birth and 1-year of age, and declined 5 percentage points between age 1 and 2. The decline in participation from age 2 to 3 years old is observed for the 1-year-olds cohort from 2001 to 2002 (column 2), or the 2-year-olds cohort from 2000 to 2001 (column 3). These cohorts both had a decline in *FSP or WIC* participation from age 2 to age 3 of less than 2 percentage points.[63]

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[63] The comparable change in WIC participation rates from age 2- to 3-years-old for different FSP cohorts indicates only a small "year effect" during the 2000-2002 time period. The "year effect" is the effect of economic factors that increase or decrease program participation over time. Comparison across columns, on the diagonals, shows only a small "year effect" across all cohorts.

Table 24—Participation in FSP and WIC for January birth cohorts

	Florida					Iowa				
	Age in January 2000									
	Infants	1-year-olds	2-year-olds	3-year-olds	4-year-olds	Infants	1-year-olds	2-year-olds	3-year-olds	4-year-olds
January births in the State[1]	17,010	16,419	16,311	16,032	15,783	3,189	3,130	3,119	3,055	3,095
In FSP or WIC ever during 2000-2002										
Number	11,742	9,488	8,466	7,446	6,085	1,837	1,580	1,367	1,157	1,008
Percent of all births in the State	69.0	57.8	51.9	46.4	38.6	57.6	50.5	43.8	37.9	32.6
Participation rates by year										
Percent in FSP *or* WIC										
2000	59.3	45.4	39.2	36.2	30.2	49.6	40.2	33.1	30.0	27.2
2001	46.5	39.6	37.5	33.7	22.3	41.2	35.4	31.3	27.8	16.0
2002	41.6	38.4	36.0	24.6	22.5	37.0	34.5	30.4	18.3	16.0
Percent in FSP *and* WIC										
2000	24.1	16.6	13.9	11.5	8.8	19.3	16.4	11.8	10.4	9.0
2001	17.8	13.8	12.9	9.7	–	16.6	14.0	12.3	9.3	–
2002	15.0	13.3	11.3	–	–	14.5	12.6	10.4	–	–
Percent in FSP only										
2000	4.6	10.4	12.2	14.0	14.6	1.4	4.2	6.7	7.0	7.6
2001	8.4	11.0	12.0	14.5	21.9	4.9	6.7	6.4	7.9	15.9
2002	11.6	12.0	13.9	23.9	22.5	7.5	8.8	9.0	18.1	16.0
Percent in WIC only										
2000	30.5	18.5	13.1	10.6	6.7	28.9	19.6	14.6	12.6	10.6
2001	20.3	14.8	12.6	9.6	–	19.7	14.6	12.6	10.6	–
2002	15.0	13.0	10.8	–	–	15.0	13.2	10.9	–	–

1 Source: Centers for Disease Control and Prevention, *National Vital Statistics Reports* (various issues). Total annual births is divided by 12 to estimate births in January. The denominator for all percentages is the total number of children in the birth cohort.
– Not applicable.

Rates of multiple program participation are shown as the "percent in FSP *and* WIC." Multiple program participation for Florida and Iowa children declines less with age than rates of participation in "FSP or WIC". (Changes in the percent of "FSP or WIC" reflect changes in three groups: FSP and WIC; FSP-only; and WIC-only.) Between birth and age one, most of the 13-percentage-point decline in overall participation for Florida children is due to a 10-percentage-point decline in children participating in WIC only; an additional 6 percentage point decline is offset by a 4-percentage-point increase in children participating in FSP only.

After age 1-year, FSP-only participation increases slightly until age 4 and then there is a large jump in FSP-only participation from age 4 to age 5, concurrent with the loss of WIC eligibility. (At age 5, children change categories from *FSP and WIC* to *FSP only*.) The increase in FSP-only participation from age 4 to 5 is 7 percentage points for the Florida cohort of 4-year-olds (2000 to 2001) and 9 percentage points for the Florida cohort of 3-year-olds (2001 to 2002). Increases in FSP-only participation of 10 and 8 percentage points are observed for the Iowa 4-year-old and 3-year-old cohorts, respectively.

Multivariate Analyses of Characteristics Associated With Multiple Program Participation

All FSP infants and children are income-eligible for WIC. As seen in previous tables, over 80 percent of FSP infants participate in WIC but only 50 to 60 percent of FSP children participate in WIC. This section examines the characteristics associated with WIC participation for infants and children participating in FSP in December 2002.

Table 25 shows descriptive statistics for FSP infants and children, as measured from FSP administrative data. Participant characteristics are age, race, relationship to household head, and receipt of TANF and Medicaid. Household characteristics include the number of adults, number of children under age five, type of household head, income as a percent of the poverty level, and residence in a metropolitan county.[64] Race categories differ somewhat across States; Florida and Kentucky FSP data did not include information on Medicaid enrollment; and Florida data did not include household income.

In the three States, the average age of FSP infants in December 2002 was 6-7 months and FSP children were an average of 36 months. The race distributions of infants and of children are comparable within State, but there are large differences across States. Over 40 percent of Florida FSP infants and children are black, 28 percent are white, and 27 percent are Hispanic. In contrast, two-thirds of Iowa FSP participants are white and over 5 percent have race coded as "unknown".[65] Kentucky FSP participants are 78 percent white and 18-19 percent black, with less than 3 percent Hispanic.

Most FSP infants and children are the sons or daughters of the FSP household head; grandchildren, however, are not uncommon and "other children" include foster children, non-relatives, siblings, and nieces/nephews. The percent of FSP infants and children also receiving TANF varies by State: from about one-fifth in Florida to about one-half in Iowa and about 90 percent in Kentucky.

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[64] A "metro" county is a county located within a Metropolitan Statistical Area (MSA).

[65] The unknown race category originally included 45 percent of infants and 14 percent of children; mother's race (when available) was used to recode unknown race of children.

Table 25—Mean characteristics of FSP infants and children, December 2002

	Infants			Children		
	Florida	**Iowa**	**Kentucky**	**Florida**	**Iowa**	**Kentucky**
Number observations	29,978	4,655	14,016	131,984	18,485	56,832
Percent matched to WIC file	87.8	83.8	94.3	50.8	56.6	56.6
Characteristics of child						
Age in months	7.2	6.6	6.4	36.0	35.9	36.2
Race						
White	27.8	65.5	78.5	27.3	69.6	78.0
Asian	0.4	0.6	0.3	0.3	0.8	0.3
Black	42.8	14.5	18.1	45.5	14.7	19.4
Hispanic	26.9	6.9	2.8	24.9	7.1	2.1
American Indian	−	0.7	0.0	−	0.8	0.0
Other race	2.1	−	−	1.9	−	−
Unknown race	−	9.4	0.2	−	6.0	0.2
Relation to HH head						
Son/daughter	86.4	96.0	92.6	88.5	97.0	94.3
Grandchild	7.4	3.4	5.7	4.8	2.1	3.6
Other child	6.1	0.6	1.7	6.7	0.8	2.1
Recieving TANF	21.6	51.6	92.7	18.1	47.0	88.4
Enrolled in Medicaid	−	96.1	−	−	94.7	−
Characteristics of household						
# Adults	1.0	1.3	1.4	1.0	1.3	1.4
# Children under 5	1.6	1.6	1.6	1.6	1.6	1.5
Type of household head						
Female head, unmarried	61.5	73.3	67.4	64.0	71.5	67.5
Married head	14.0	21.5	28.0	14.4	22.6	27.8
Male head, unmarried	4.8	2.2	2.2	5.4	2.9	3.0
No adults in household	22.1	3.3	2.4	19.0	3.2	1.8
Income as % poverty	−	38.9	45.1	−	43.1	50.2
Resides in Metro county	90.7	53.0	41.6	91.0	51.7	42.1

  − Data not available.

The average number of adults in the FSP household ranges from 1.0 in Florida to 1.3 in Iowa and 1.4 in Kentucky. The number of children under age 5 is virtually the same across States (1.6 in all categories except 1.5 for Kentucky children). The household head is characterized as either married, unmarried male or female, or "no adults in household." Married household heads comprise less than 30 percent of FSP households with infants and children in all three States. The percent with married heads varies: 28 percent in Kentucky, 22 percent in Iowa and 14 percent in Florida. FSP households with no adults are more common in Florida (about 20 percent versus about 3 percent in Iowa and about 2 percent in Kentucky). The percent of FSP infants and children residing in metropolitan areas varies from 91 percent in Florida to 53 percent of Iowa and 42 percent in Kentucky.

Table 26 shows the results of multivariate logistic regressions. The dependent variable is the binomial "match" variable denoting whether the FSP participant was enrolled in WIC in December 2002. Logistic regressions were specified without county dummies (Model 1) and with county dummies (Model 2). The county dummies capture any effect that is shared by participants within a county that

is not already captured by other variables included in the regression. Such effects may include differences in local WIC agency funding levels or differences in WIC outreach efforts at the local level. Nearly all Florida local agencies are county agencies; about 75 percent of Kentucky local agencies are county agencies, while 25 percent are local health departments; and local agencies in Iowa include a mix of county health departments and community organizations with jurisdictions that may not coincide with county boundaries.

Logistic regression results are presented in table 26 as odds ratios. An odds ratio greater than one indicates that the variable is positively associated with WIC participation; an odds ratio less than one indicates negative association. The odds ratios are for a one-unit change in continuous variables (e.g., age and poverty). For binomial variables (e.g., race indicators), the odds ratio is the odds of WIC participation for someone with the characteristic compared to someone without.[66]

The model statistics include the log-likelihood, Nagelkerke R-square, and Hosmer-Lemeshow goodness of fit test. The R-square statistics indicate that no more than 15 percent of the variation in WIC participation rates is explained by available variables. R-squares are very low for the infant models without county dummies, largely because participation rates are above 80 percent for infants (i.e., nonparticipation is somewhat rare). The Hosmer-Lemeshow tests have Chi-squares with p values greater than .05 for all models except Florida children (model 1) and Kentucky children (model 2), indicating that the model fits the data at an acceptable level. While explanatory variables are limited by available data, many of these variables attain statistical significance, except in the Iowa infant models.

Results are shown in table 26 separately for infants and children. The infant models did not produce consistent results across States, while the children models provided many consistent results across States. For FSP infants, age in months and TANF participation were positively associated with WIC participation in Florida and Kentucky, but not in Iowa. The Florida data show that residing with a grandparent has a large impact on the odds of WIC participation for FSP infants. Number of adults in the household increases WIC participation in Florida, but number of children under age 5 reduces the likelihood of WIC participation in Florida and Kentucky.

In Florida, black and Hispanic FSP infants were more likely to participate in WIC than white FSP infants (36 and 43 percent more likely, respectively). Black FSP infants were also more likely to be WIC participants in Kentucky. Race was not related to WIC participation among Iowa FSP infants, except the "unknown" race category.

For FSP children, the characteristics related to WIC participation showed consistency across States with the exception of race. Hispanic FSP children were more likely to participate in WIC than white FSP children in Florida and Kentucky (70 percent and 87 percent more likely respectively). Black FSP children were less likely to participate in WIC than white FSP children in Iowa and Kentucky (23 percent and 6 percent less likely, respectively – according to model 2).

For FSP children in all three States, the likelihood of WIC participation declines 2 percent with every month increase in age. The number of adults in the household, number of children under age five,

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[66]   The odds ratio may be thought of as an approximate relative risk. An odds ratio of 1.2 indicates that WIC participation is 20 percent more likely for a person with the characteristic than one without.

Table 26—Characteristics associated with WIC participation: Odds ratio estimates from logistic regressions

	Infants					
	Florida		Iowa		Kentucky	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Number observations	29,978	29,978	4,655	4,655	14,016	14,016
Characteristics of child						
Age (months)	1.04 *	1.04 *	1.00	1.00	1.09 *	1.09 *
Race[1]						
Asian	0.66	0.70	0.85	0.78	1.51	1.82
Black	1.20 *	1.36 *	1.17	1.13	1.00	1.31**
Hispanic	1.35 *	1.43 *	0.94	0.79	1.09	1.24
American Indian	–	–	0.86	0.89	–	–
Other race	0.81	0.88	–	–	–	–
Unknown race	–	–	0.47 *	0.53 *	1.03	1.42
Relation to HH head[1]						
Grandchild	1.31 *	1.26 *	0.85	0.90	1.02	1.03
Other child	1.03	1.00	1.71	1.70	0.52 *	0.51 *
Recieving TANF	0.98	1.10**	0.93	0.92	2.72 *	2.71 *
Enrolled in Medicaid	–	–	1.03	1.07	–	–
Characteristics of household						
# Adults	1.16 *	1.17 *	1.20	1.20	1.18	1.14
# Children under 5	0.88 *	0.85 *	0.91	0.91	0.78 *	0.77 *
Type of household head[1]						
Married	0.87 *	0.89	0.87	0.88	1.19	1.12
Male head, unmarried	1.06	1.12	1.02	1.05	0.58 *	0.55 *
No adults in household	1.06	1.11	1.08	1.12	1.09	1.31
Income as % poverty	–	–	1.00	1.00	1.00 *	1.00 *
Resides in Metro county	0.94	–	1.09	–	0.62 *	–
County dummies included	no	yes	no	yes	no	yes
Model statistics						
R-Square	0.01	0.08	0.02	0.06	0.05	0.10
Log Likelihood	-11069.7	-10499.6	-2031.4	-1979.0	-2930.9	-2818.4
Hosmer-Lemeshow goodness of fit test						
Chi-square	7.39	14.92	4.45	6.90	6.61	10.49
P value	0.49	0.06	0.81	0.55	0.58	0.23

[1] Omitted categories are: Race=white, Relation to head=own child, Type of household head=Female head, unmarried.
– Data not available.
 * Denotes significance at <.01 level.   ** Denotes significance at <.05 level.

married household head, and participation in TANF are positively related to WIC participation.[67] A married household head increases the likelihood of WIC participation for FSP children by 25 to 39 percent across States. In all three States, children in households with no adults are also more likely to participate in WIC than children in female-headed households, but children in no-adult households are rare in Iowa and Kentucky. Residence in a metropolitan area is negatively related to WIC participation in all three States, even though the percent residing in metropolitan areas varies from 42 percent in Kentucky, to about 52 percent in Iowa and 91 percent in Florida.

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[67] Removing TANF from the model does not change the estimates on the marital status of the household head.

	Children					
	Florida		Iowa		Kentucky	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Number observations	131,984	131,984	18,485	18,485	56,832	56,832
Characteristics of child						
Age (months)	0.98 *	0.98 *	0.98 *	0.98 *	0.98 *	0.98 *
Race[1]						
Asian	1.06	1.21	0.69 *	0.73	1.11	1.53**
Black	0.83 *	0.98	0.77 *	0.77 *	0.79 *	0.94**
Hispanic	1.39 *	1.70 *	1.08	1.14	1.62 *	1.87 *
American Indian	–	–	0.99	0.95	–	–
Other race	0.94	1.09**	–	–	–	–
Unknown race	–	–	0.51 *	0.51 *	0.93	1.21
Relation to HH head[1]						
Grandchild	1.01	1.04	1.16	1.18	1.41 *	1.40 *
Other child	1.04	1.02	0.94	0.94	0.98	0.98
Recieving TANF	1.12 *	1.17 *	1.33 *	1.33 *	1.80 *	1.79 *
Enrolled in Medicaid	–	–	1.18 *	1.19 *	–	–
Characteristics of household						
# Adults	1.20 *	1.19 *	1.24 *	1.23 *	1.11 *	1.08 *
# Children under 5	1.23 *	1.22 *	1.44 *	1.44 *	1.29 *	1.31 *
Type of household head[1]						
Married	1.32 *	1.34 *	1.25 *	1.26 *	1.39 *	1.33 *
Male head, unmarried	1.01	1.03	0.86	0.89	0.97	0.92
No adults in household	1.57 *	1.69 *	2.54 *	2.71 *	1.77 *	1.82 *
Income as % poverty	–	–	1.01 *	1.01 *	1.00 *	1.00 *
Resides in Metro county	0.66 *	–	0.87 *	–	0.57 *	–
County dummies included	no	yes	no	yes	no	yes
Model statistics						
R-Square	0.06	0.10	0.09	0.10	0.11	0.15
Log Likelihood	-88198.4	-86509.1	-12013.4	-11903.4	-36349.2	-35577.8
Hosmer-Lemeshow goodness of fit test						
Chi-square	31.32	13.71	7.77	8.04	9.74	17.86
P value	0.00	0.09	0.46	0.43	0.28	0.02

[1] Omitted categories are: Race=white, Relation to head=own child, Type of household head=Female head, unmarried.
– Data not available.
* Denotes significance at <.01 level.   ** Denotes significance at <.05 level.

Iowa FSP data include a measure of Medicaid enrollment. The logistic regression results indicate that children enrolled in Medicaid are 19 percent more likely to participate in WIC, all else equal. This result is consistent with the TANF result. Since the regressions are limited to FSP participants, the Medicaid and TANF results suggest that WIC participation is more likely when children are enrolled in *multiple* other public assistance programs.

Iowa and Kentucky FSP data include a measure of income, which is expressed as a percent of the poverty level in the logistic regressions (with a scale of 1 to 100). Income is positively associated with WIC participation, although the magnitude of the effect is small. In Iowa, WIC participation is

one percent more likely with every one percent increase in income expressed as a percent of the poverty level.[68] (The Kentucky odds ratio for income is 1.005.)

Overall, the logistic regressions suggest that WIC participation by FSP children declines with age and is negatively associated with residence in a metropolitan area. WIC participation is positively associated with black and Hispanic race/ethnicity, a married household head, receipt of TANF, and the number of adults and children under age 5 in the household.[69] There is also evidence from the Iowa data that WIC participation by FSP participants is more likely when families also participate in Medicaid.

Comparison of Match Methods

An important question for this study was evaluation of probabilistic record linkage methods relative to other matching methods. This comparison depends on the availability and quality of individual identifiers. Table 27 shows match results by four different match-merge specifications and by probabilistic record linkage. The four methods used for match-merge were: merge by SSN (except for Iowa), merge by name and date of birth, merge by SSN or name and date of birth, merge by FSP/TANF/Medicaid ID number (Florida only).

Match-merge methods produced match rates that were lower than the rates achieved by probabilistic record matching. Merge by "SSN or name and date of birth" produced match rates within one percentage point of probabilistic matching for Florida and Kentucky, and within four percentage points in Iowa. Merge results depend on the presence of nonmissing identifiers. For Florida and Iowa infants, the merge methods relying on only one identifier performed poorly due to missing data for those identifiers.

The performance of match-merge methods cannot be evaluated solely on the overall match rates. The bottom panel of table 27 shows the percent of false positive and false negative matches, based on comparison of match-merge results to probabilistic record matching results. False positives are defined as a match of records belonging to two different people. False negatives are defined as failure to find a match between records for the same person. When merging by SSN, the prevalence of false positives is low, indicating a high quality of SSN information in both FSP and WIC administrative records.[70] The prevalence of false negatives, however, is more than 6 percent overall and is 17 percent for infants. When merging by name and date of birth, the prevalence of false positives ranges from less than one percent in Florida to 7 percent in Iowa, reflecting varying data quality or different degrees of homogeneity in the data.[71] False negatives are mainly in the 5 to 7 percent range when merging by name and date of birth.

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[68] Income expressed as a percent of the poverty level is standardized for household size.

[69] Bitler, et al. (2003) examined the correlates of WIC participation in administrative data, CPS, and SIPP. Their results are consistent with the findings presented here. They found that WIC participation is positively associated with Hispanic ethnicity and being married, and negatively associated with Asian ethnicity and residence in a metropolitan area. They also found that WIC participation is higher in States requiring fewer visits to the WIC office.

[70] FSP validates SSN but WIC does not.

[71] Homogeneity results in false positives if particular names are common within a State.

With the exception of infants, simple match methods resulted in few false positives but significant numbers of false negatives. These results suggest that simple merge methods may be adequate for some research purposes, depending on data quality and incidence of missing identifiers.

Table 27—Percent of WIC participants matched to FSP by different match methods, December 2002

	Number WIC participants	Percent of WIC participants matched to FSP					
		Match-merge methods				Probabalistic linkage	
		By SSN	By Name & DOB	By SSN or Name & DOB	By FSP/TANF/ Medicaid ID	With SSN	Without SSN
Florida							
Total WIC	403,477	21.9	23.9	27.3	20.6	28.3	–
Women	98,606	19.9	19.0	21.4	19.6	21.7	–
Infants	112,352	6.7	19.4	20.7	2.0	23.6	–
Children	192,519	31.8	29.0	34.1	31.9	34.5	–
Iowa							
Total WIC	70,239	–	22.8	22.8	–	–	26.6
Women	16,985	–	20.3	20.3	–	–	25.5
Infants	17,227	–	20.0	20.0	–	–	22.0
Children	36,027	–	25.4	25.4	–	–	29.2
Kentucky							
Total WIC	131,174	38.4	38.9	44.2	–	45.1	44.8
Women	32,738	41.8	37.4	42.0	–	42.1	41.5
Infants	33,965	21.0	32.4	36.1	–	38.2	38.1
Children	64,471	45.9	43.1	49.6	–	50.2	50.0

‾ Data not available.

	Percent in error when matched by					
	SSN		Name & DOB		FSP/TANF/ Medicaid ID	
	False positive	False negative	False positive	False negative	False positive	False negative
Florida						
Total WIC	0.4	6.5	0.2	4.5	0.3	7.8
Women	0.1	1.8	0.0	2.7	0.1	2.1
Infants	0.9	16.9	0.4	4.2	0.8	21.6
Children	0.2	2.7	0.1	5.6	0.2	2.7
Iowa						
Total WIC	–	–	6.5	5.2	–	–
Women	–	–	0.0	5.2	–	–
Infants	–	–	11.8	4.4	–	–
Children	–	–	6.9	5.6	–	–
Kentucky						
Total WIC	0.4	6.7	1.0	6.5	–	–
Women	0.1	0.3	0.1	4.7	–	–
Infants	1.0	17.4	3.5	7.0	–	–
Children	0.2	4.4	0.2	7.1	–	–

‾ Data not available.

Chapter Five
Summary and Conclusions

This study investigated the feasibility of linking administrative data from multiple USDA food assistance and nutrition programs (FANPs) for three States. Linked data provide a means of examining rates of multiple program participation, dynamics of participation across programs, and the characteristics of families who participate in some, but not all FANP programs for which they are eligible.

FSP and WIC data were matched using probabilistic record linkage methods, implemented with software from the U.S. Census Bureau. This software requires an understanding of the theory and application of probabilistic record linkage methods. For this study, the greatest difficulty in building linked files was due to the volume of data received for the three-year period for which administrative data were collected.

Probabilistic record linkage yields higher match rates when compared with simpler match methods, such as a merge by SSN or by name and date of birth. For the three States examined in this study, it was found that simpler match methods yielded relatively high rates of false negatives (failure to find a match between records for the same person), but very low rates of false positives (matching records for different people). False negatives were in the range of 5 to 8 percent, while false positives were less than one percent. Simpler match methods are most likely to yield unacceptable results for infants, who often have missing key identifiers in administrative data.

Match results showed that, for the three States studied, 84 to 94 percent of FSP infants participated in WIC during a single month; and 89 to 96 percent of FSP infants participated in WIC at some point during a three-year period. Among FSP children, 51 to 57 percent had contemporaneous WIC participation, and 61 to 74 percent of FSP children participated in WIC at some point during the three-year period. The latter estimates underestimate the percent of FSP children *ever* participating in WIC because the data were limited to a three-year period and participation histories are truncated.

The prevalence of contemporaneous FSP participation by WIC participants was estimated to be 28 percent in Florida, 26 percent in Iowa, and 45 percent in Kentucky. For Florida and Iowa, the match rates for WIC participants were consistent with the overall rates of reported FSP participation in the WIC administrative data. For Kentucky, the match rates suggest that WIC participants underreport FSP participation to the WIC program. The percent of WIC participants exposed to FSP during the three-year period was 52 percent in Florida and 55 percent in Iowa (this statistic could not be estimated for Kentucky).

Examination of birth cohorts through age five shows that overall program participation (participating in either FSP or WIC) declines with age, with most of the decline due to declining WIC participation at age 1 and at age 5 when WIC eligibility ends.

Multivariate analyses indicate that age, race/ethnicity, and household characteristics have a statistically significant association with WIC participation among FSP infants and children. Results were more consistent across States for children, than for infants. For FSP children, WIC participation declines with age. Household characteristics positively associated with WIC participation among FSP

children include: the number of adults in the household, the number of children under age five, and a married household head. Residence in a metropolitan area is negatively associated with WIC participation. The likelihood of WIC participation across racial/ethnic groups varied across States. Hispanic children in Florida and Kentucky were more likely to participate in WIC than other racial/ethnic groups, and black children in Iowa and Kentucky were less likely to participate in WIC than other racial/ethnic groups.

Multivariate analyses shows that receipt of TANF is positively associated with WIC participation among FSP children in all three States. Information about Medicaid enrollment was available only from Iowa and shows that Medicaid enrollment is also positively associated with WIC participation. Since the analysis was limited to FSP participants, the Medicaid and TANF results suggest that WIC participation is more likely when children are enrolled in *multiple* other public assistance programs.

The results from this report cannot be generalized beyond the three States included in the study. The range of issues examined, however, can be applied to further studies. Linked administrative data may be less costly than survey data and provide a means of examining a large number of issues associated with multiple program participation. For example, the current study might be replicated with a larger time period so that the interaction of FSP and WIC can be examined for cohorts of children from birth to age 5. These methods may also be applied to data from other public assistance programs. Unfortunately, NSLP data were not available to this study, but future efforts to link NLSP and FSP could help us understand variations in FSP participation rates.

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